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AN ASSESSMENT OF TURKISH DEFENSE INDUSTRY AND TURKEY'S EFFORTS TO TRANSFER MILITARY TECHNOLOGY: STRATEGIES FOR ARMING THE FUTURE

by

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ABSTRACT

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LIST OF ACRONYMS

AQAP	: Allied Quality Assurance Publications
CMI	: Civil-Military Integration
GDP	: Gross Domestic Product
GNP	: Gross National Product
MoND	: Ministry of National Defense (of Turkey)
R&D	: Research and Development
SAGE	: Defense Industries Research and Development Institute (of Turkey)
SIPRI	: Stockholm International Peace Research Institute
SSM	: Undersecretariat for Defense Industries (of Turkey)
TAFF	: Turkish Armed Forces Foundation
TAFs	: Turkish Armed Forces
TDI	: Turkish Defense Industry
TDITB	: Turkish Defense Industry and Technology Base
TGNA	: Turkish Grand National Assembly
TUBITAK	: The Scientific and Technical Research Council of Turkey

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I. INTRODUCTION

A. GENERAL

In the years following the establishment of the republic, Turkey had to establish the infrastructure of an effective defense industry to cope with the various external threats and to eliminate these threats whenever necessary. Nevertheless, despite all efforts and all resources allocated to fulfill this aim, various factors have obstructed the materialization of this goal. Insufficiencies in planning, the allocation of resources in support of industrialization and providing qualified cadres to meet the challenges involved in meeting these targets have all become obstacles on the way to real progress.

Due to its failure in building up a self-sufficient defense industry that could provide Turkish Armed Forces with major defense equipment, Turkey became heavily reliant on its allies in NATO, mostly the US.

Based on lessons learned from the arms embargoes against Turkey, especially the US embargo after the country's intervention in Cyprus in 1974, Turkey decided to develop its own defense industry, aiming to reach a high level of self-sufficiency in supplying its armed forces with state-of-the-art weapon systems and defense equipment.

Finding itself caught at the intersection of three points of regional instability formed by the Balkans, the Caucasus, and the Middle East, Turkey is continuing to field the second largest armed forces in NATO and to expand its national defense industry to support its armed forces. As a percentage of the GNP (approximately 4 percent) and of the Consolidated Budget (approximately 15 percent), Turkish defense spending is among the highest in NATO; and among all the world's nations. However, Turkey still obtains 79 percent of its defense equipment through imports. With only 21 percent produced by the national defense industry, the level of domestic production is very low considering the size of the armed forces and the level of defense expenditures.

Reduced military support from the allied countries, due to different disputes with Ankara, gave a big boost to Turkey's efforts to transfer military technology; in order to create a minimum required technological base, emphasis in Turkey has shifted from direct procurement to co-production of weapon systems, thereby developing a sustainable defense industrial base.

Turkey recently accelerated its efforts to ready itself for the 21st century by setting up effective and productive defense industry projects with maximum local input. Such efforts are expected to prevent it from lagging behind in the 21st century's rapidly developing defense sector.

Currently, the Turkish Defense Industry and Technological Base (TDITB) have been giving two different impressions. On one hand, Turkey's efforts to gain new capabilities, like manufacturing battle tanks and helicopters, puts the TDIBT in the category of developing countries. On the other hand, most of the companies, which were established during the last couple of decades in a reactionary approach rather than proactively forming a national defense industry with long-term planning, have strongly been aware of the need to restructure in order to overcome the challenges in the national and international environment. Most of the projects that these companies were originally set up for have been completed and there is a very severe competition in the export markets, which looks like the only way for keeping their production lines open. Moreover, the irregularity of the government's approach towards these organizations seems to be short of emphasizing the need that the stability of these establishments is critical for a self-sufficient national defense industry. Due to the crisis in the country's economic health, which has been immune to such crisis every five to six years, political authorities have been showing reluctance to allocate sufficient funding to the development of the defense industry. The authors of this thesis attribute this fact to the lack of long-term defense industrial policies (or of a development and

restructuring plan), with inadequate commitment by all parties involved.

B. AREA OF RESEARCH

This thesis investigates the Turkish Defense Industry and Turkey's efforts to transfer military technology to establish a required technological base for a self-sufficient defense industry, which can fulfill the needs of the Turkish Armed Forces (TAFs) and stay competitive in a rapidly changing market place. The goal of this project is to evaluate the present Turkish Defense Industry and to present strategies that should be carefully considered in developing a sound defense industry and technological base policy. It addresses the defense industry and technology transfer issues as well as Turkey's security policy and future defense requirements. Research includes:

- Conducting a comprehensive analysis of defense industries and related issues in general and Turkish Defense Industry in particular.
- Examining technology transfer and particularly the transfer of military technology.
- Predicting Turkey's future defense requirements, and suggesting strategies for developing a defense industry and technological base that can fulfill these requirements.

It is the researchers' intent to provide all the parties interested in TDITB with a comprehensive source of information in the related areas and to contribute to the efforts to create a

knowledge base in Turkey, regarding the fields of the defense industrial base and technology transfer.

C. RESEARCH QUESTIONS

The Primary question this research addresses is:

- What should be the strategies that Turkey should adopt to develop a self-sufficient defense industry and technological base, which will meet the future requirements of the Turkish Armed Forces?

To answer the primary question, the following subsidiary questions have been addressed as well:

Questions Related to the Defense Industry

- What is the defense industry?
- Why does a country need to establish a defense industry?
- What are the benefits and costs of having a defense industry?
- What is the relationship between science, technology, and the defense industry?
- How do international relations affect the defense industry?
- How does the economy affect the defense industry?
- What are the characteristics of the defense market?
- What is likely to happen to the defense market?
- What are the general trades?

- How will the changing markets affect the Turkish Defense Industry?

Questions Related to the Technology Transfer

- What is technology transfer and what factors affect the technology transfer?
- What are the types and methods of technology transfer?
- What are the advantages and disadvantages of technology transfer?

Questions Related to the Transfer of Military Technology

- Why do nations need to transfer military technology?
- Which sources do nations transfer military technology from?
- What are the strategies for the transfer of military technology?
- What are the restrictions and the challenges of the transfer of military technology?
- How do nations transfer military technology?
- What are the results of the transfer of military technology transfer?

Questions Related to the Turkish Defense Industry

- What is the current state of the Turkish Defense Industry ?
- Which factors obstructed the development of it?
- What is the Turkish Government's defense policy?

- What are the current defense projects?
- What is the technological level of the Turkish Defense Industry?
- What is the level of the defense expenditures in Turkey?
- From what resources does this money come?
- What is Turkey's national security policy?
- How is the Turkish Defense Industry affected by it?
- What is Turkey's defense policy and military strategy and how is the Turkish Defense Industry affected by it?
- What are the desirable characteristics of the future Turkish Defense Industry?
- What are the Turkish Armed Forces' future requirements?
- Which factors affect the future requirements of the Turkish Armed Forces?

D. METHODOLOGY

To describe and to analyze current and future trends for the defense industry and the transfer of military technology in Turkey, as well as worldwide, and the Turkish security policy, this thesis research makes use of industry literature, trade publications, United States, Turkish and several other international government and non-government resources, and professional publications. Specific and

detailed background information is provided regarding the defense industries and technology transfer.

Current events as described in several written and electronic publications are investigated and used in this research.

E. THE ORGANIZATION OF THE STUDY

This research is organized to include: (1) an overall and detailed review of the defense industry and related issues, (2) an in-depth review of technology transfer, particularly the transfer of military technology, (3) an evaluation of the current situation of the Turkish Defense Industry and Technological Base, (4) predicting the future requirements of the Turkish Armed Forces and (5) an analysis of the strategies that Turkey can adopt to build a self-sufficient defense industry.

Chapter I presents the study. Chapter II and III address the general issues about the Defense Industry and Technology Transfer topics. Chapter IV looks into the Transfer of Military technology for creating a minimum required defense industrial and technological base.

Chapter V and VI give a background on Turkey's aggressive efforts to develop a national defense industry and the factors that obstructed the development of the Turkish Defense Industry, in addition to the current structure and capabilities of today. It

includes information about defense expenditures and financial resources, military modernization programs, and the current defense projects.

Chapter VII looks into the future defense requirements of Turkey and outlines the capabilities and the characteristics of the future defense industrial base that will provide the Turkish Armed Forces with a state-of-the-art weapons system and defense equipment.

Chapter VIII presents and discusses the strategies that have been experienced in other countries, that have both lived through periods of a defense industry build-up and draw-down. These strategies should be taken into consideration so as to develop and maintain a robust domestic defense industry.

Chapter IX draws conclusions and presents the proposals of the authors' recommendations.

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II. THE DEFENSE INDUSTRY

A. WHAT IS THE DEFENSE INDUSTRY

1. Definition of the Defense Industry

The defense industry (or the defense industrial base: These two terms will be used interchangeably throughout this theses) is defined as "the combination of people, institutions, technological know-how, and the production capacity used to design, develop, manufacture, and maintain the weapons and supporting defense equipment needed to achieve a nation's security objectives" [Ref. 1: p.5]. In this sense, the defense industry is a subset of the national industry.

The defense industry is multi-dimensional and it can be divided into several tiers: prime contractors, subcontractors, and lower tiers that include suppliers of parts and raw materials. It consists of companies that provide facilities supporting air, land, and sea systems [Ref.2: p.184]. While the defense industry and technology base is often discussed as if it were an independent entity, it is really interwoven with the nation's civilian technology and industrial base and increasingly, with the global economy.

Due to its multi-dimensional aspects and the varying degrees of dependence on defense sales, it is difficult to develop any comprehensive defense industry policy. Therefore, the defense industry should not be treated as a "single, homogeneous entity."

The three components of the defense industry are: technology, production, and maintenance. The technology component includes private industry, university, government laboratories, research facilities, and test centers that conduct research. The production component consists of private and public manufacturing facilities, including government-owned and contractor-operated, or government-owned and government-operated, or contractor-owned and contractor-operated facilities. The maintenance component consists of private and government facilities (such as arsenals and depots) that maintain and repair equipment [Ref. 1: p.5].

2. Importance of the Defense Industry

Nations have always placed great importance on the development of a domestic defense industry for several reasons. Firstly, a strong defense industry is deemed to be the key component of national power, providing the nations with the capability to respond to unforeseen contingencies, and to deter threats from other nations. The history of mankind has proven that well equipped and technologically superior forces are needed to prevent aggression. In addition, a defense dependent upon imported weapons and equipment is likely to lead to political subordination to the exporting nation. Moreover, advanced nations are increasingly

unwilling to transfer their military technology, so they can increase their control over sales.

3. Benefits of a Defense Industry

There are several benefits of maintaining a strong defense industry; among the most significant are self-sufficiency, less reliance on foreign supply, leverage, economic benefits, and security.

a. Self Sufficiency and Capabilities

Self-sufficiency enables nations to maintain a capability that they believe they will need in the future, and enables them to avoid the cost and time required recreating it. On the other hand, it should be noted that no single nation is able to provide 100% of domestic materials and suppliers.

b. Less Reliance on Foreign Supply

A nation without a defense industry may have to rely upon foreign suppliers, which may leave the buyer vulnerable to such risks as unavailability during a crisis due to internal and/or external political pressures, monopoly price increases, weapons and equipment designed and manufactured for the originating country's needs rather than the threat facing the purchaser.

On the other hand, a domestic defense industry can prevent a nation from becoming entirely locked in to the use of foreign suppliers, which might bear the above mentioned risks.

c. Leverage

A country with a strong defense industry can use that leverage when negotiating with foreign firms. A country with a small defense industry may just as easily threaten to go to a rival supplier on the world market. Countries can use this leverage to encourage suppliers to provide weapons and equipment with the latest technology or tailored to meet the purchasing country's needs.

d. Economic Benefits

According to Sandler, a domestic defense industry provides national economic benefits [Ref.3: p.185]. These benefits take the form of new jobs, technological advances, and exports. However, this line of thinking seems to ignore the fact that those same resources could possibly be used more efficiently in other sectors of the national industry. When looking at the nation as a whole, there is no evidence that money spent on defense creates more jobs or benefits the economy greater than the money spent in the private sector.

e. Security

It has been argued that there is a close relationship between national power and the nation's manufacturing capability

[Ref.4: p.1]. "As the period between crises increases, the defense industry grows cold from neglect and the risk to national security increases correspondingly." [Ref.5: p.27] A strong defense industry can serve as a deterrent to potential adversaries.

4. Costs of a Defense Industry

There is a lack of quantitative data on the cost of maintaining a domestic defense industry. The cost of maintaining national independence may be a lack of inter-operability with foreign suppliers in an alliance [Ref.2: p.185]. The cost of maintaining a capability which a nation believes will be required in the future could be measured in the purchase of an item not necessarily needed for defense but purchased to keep a production line "warm."

There are other costs involved in not using foreign suppliers. The exclusion of foreign sources in order to promote self-sufficiency may result in monopoly prices from domestic suppliers and lack of efficiencies and innovation associated with a competitive marketplace, resulting in overall higher life cycle costs. Foreign suppliers may be members of a military alliance such as NATO where standardization and inter-operability are necessary. Members of the alliance could elect not to use a sole-source and there is a cost associated with inter-operability among several suppliers.

Moreover, for most or nearly all countries, maintaining a robust defense industry depends on the ability to sell military goods internationally. In the absence of international sales, a broad and robust defense sector is most likely unaffordable.

5. Characteristics of the Defense Industry

The defense industry has different characteristics than the other types of civilian industries. In particular, the defense industry is a national industry, to ensure that the political, economical and social development of the nation and stability of national security is its first requirement.

Second, the government is the only demander for defense industry products. These products are generally manufactured on a contract between the government and the industry.

Third, highly precise production technologies and highly skilled technical manpower are required to produce defense industry products along with special quality standards. Extensive research and development (R&D) activities are inevitable requirements to keep abreast of the technology.

Fourth, while it takes a longer time to prepare for military production and a return on the large amount of investment capital, new technology soon becomes outdated due to rapid changes in weapon systems. Not only are the defense choices complex, but they

have to be made in a world of uncertainty. No one can predict the future accurately. Today's threat might be tomorrow's ally; today's technology equipment might be tomorrow's dreadnought [Ref. 6:p. 26].

Finally, defense industry activities have a secrecy that is inherent in military technology, so they should be kept classified.

6. Basic Military Criterion for Defense Industry Products

a. Secrecy

The secrecy feature of the weapons system and other defense equipment requires that only the users know the strengths and weaknesses of these products. The frequency of the guidance system of a missile, firing rate of an artillery weapon or such features of defense products should be kept secret. Otherwise, the conflicting countries may develop countermeasures that may decrease the effectiveness of these systems.

b. Security And Reliability

It must be assured that weapon systems and other defense equipment will function when required. Therefore, utmost attention must be given to ensure the security of the computer systems and the communication systems to prevent the interference of adversaries.

c. Flexibility and Survivability

Defense industry products must have the capacity to be adaptable to the changing threats and developing technologies. It usually takes 5-10 years or even longer to fully develop and activate a weapons system. When activated, a weapons system is utilized for about 20 years. Combining these two facts, the systems must have the capability to encounter the threats for 25-30 years. Moreover, the ever-changing technological developments necessitate that defense systems be designed and developed with the flexibility to be adapted to new developments.

d. Standardization

In order to provide the coordination between the military units, logistics, training support, and to decrease overall maintenance costs, the defense system in a nation's armed forces should have a high degree of standardization.

7. Characteristics of Defense Systems

a. Complex Configuration

Most defense systems have complex configurations that comprise sub-systems like sensor systems and communication systems, all of which are particular defense products. The design and development of a defense system requires the close scrutiny of

all sub-systems and components to provide the effectiveness and the efficiency required of these systems.

b. Intensive Use of High Technology

The ability to design and develop high-tech defense systems has been one of the outstanding criteria in comparing the military strength of nations for the last 50-60 years, just as more conventional technology has provided military advantage for many centuries. The use of electronic technology has become an important aspect of defense system production activities. The decreasing sizes of the circuit boards have enabled the industry to produce smaller, faster, more energy-efficient and highly capable defense products. Today, it is almost impossible not to use electronic components in assuring the functionality of defense systems.

c. High Life-Cycle Cost

The intensive use of the high technology, the complex configuration of the modern defense system, and the need to collect and to document the relevant data in a systematic way requires the use of highly skilled technical manpower and precise production technologies that demand an immense capital investment. All these factors increase the life-cycle costs of such systems, and bring forth the need to focus on the requirements of the buyers and the reliance of the financial support from them.

d. Long Operating Life

Defense systems have a longer average operating life than any other commercial product in the world market. High life-cycle costs that include all the costs from design and development costs to user training, maintenance infrastructure, and technical staff costs have all contributed to the need to utilize such systems for longer periods of time that turn out to be more than 30 years for some systems. This time lag between the introduction of the new system and the ever-changing environment of threats and technological systems require the upgrade of defense systems at specific times.

e. High Product Quality

High quality standards and tests in all phases of the design, development, and the production of defense systems is another significant distinction of the defense industry products. Systems and the products must be in full compliance with the specifications determined by the procuring government.

Some countries not only require the compliance of the systems and products with the standards, but obligate the establishment of quality assurance systems in accordance with the international standards in production facilities of the defense companies. Accordingly, NATO has defined the quality assurance

systems that the companies operating in the defense industry should establish in AQAP (Allied Quality Assurance Publications).

f. Endurance in Heavy Conditions

Defense industry products must be able to operate under difficult environmental conditions such as desert, polar climates, and/or under intense dust. Systems should have the ability to properly function whatever the conditions are. This demanding characteristic requires the incorporation of different approaches in all phases of product conceptualization, design, development, inspection and maintenance.

8. Characteristics of Defense Industry Companies

a. Company Size

The companies in the defense industry stand out among the other companies in the national industry due to their capital intensity and human resources. As mentioned previously, production of the defense systems requires a large amount of capital investment, precise production technologies, highly skilled technical manpower and extensive R&D activities. All these factors increase the size of the defense companies.

b. Organizational Structure

The large companies that operate in the defense industry have some very unique design features. Among others, in order to

ensure the specialization and increase the motivation of the members, these companies generally consist of decentralized units, which have freedom in decision-making. For instance, companies like General Dynamics, Litton, and United Technologies are comprised of a corporate headquarters and several divisions, which help benefit from the consolidated financing, international marketing, and R&D functions as well as the dynamism of the smaller units.

c. Human Resources

The size and the quality of the human resources are another important feature of the defense companies. Defense industry activities are managed and conducted by highly educated key personnel. Moreover, defense projects require manpower, who have been educated in special areas such as systems engineering, contract administration, cost/price analysis, and integrated logistics systems.

d. Project-Oriented Organization

Project-oriented organization and management has been an important feature of the defense companies since the 1940s. Teams have been formed for a particular time and purpose to carry out defense projects. The Project Office, Project Manager, single coordination point, and such phenomenon often work within matrix organizations in defense companies.

B. SCIENCE, TECHNOLOGY AND THE DEFENSE INDUSTRY

In today's world, the competition for better products has taken the form of a quest to introduce more technologically and scientifically efficient products. In most industries, increased efforts in research and development, the use of modern communication networks and information technologies, know-how, and concentration on core competencies have replaced the classical factors of having a competitive edge such as cheap labor and excessive raw material.

As the combination of such sub-industries, the defense industry has been creating value and contributing to the economical development and welfare of the nation by improving the scientific and technologic infrastructure of the country.

1. Technological Goals of The Defense Industry

There is a close relationship between the effectiveness of the defense system and their level of technological development. Therefore, the goal of developing high technology has been the focal point of product development and production re-engineering processes in defense industries. In order to increase the effectiveness and self-sufficiency, countries have been heavily engaged in developing the required technologies instead of transferring them from other countries. In this sense, universities

and research institutions have been granted funds to conduct research and development activities for defense industries.

2. Importance of R&D Centered Defense Industry for the Efficient Use of National Resources

Compared to the commercial products and services, high-tech defense systems and products are produced in lesser quantities with higher development, production and operation costs and cannot be foregone due to the inevitability of defense needs. Since research and development expenditures constitute a significant part of the cost of a procured defense system or product, the design and development of such products domestically saves a great deal of national funds from going out of the country and helps fund the development of the national science and technology base. However, it consumes national resources that instead could be used for other national priorities.

3. Contributions of The Defense Industry to National Science and Technology Base

The defense industry has always been in search of new products and systems that push the limit of the current technologies. Therefore, with the appropriate plans and policies, the defense industry can sometimes make big contributions to the improvement of a nation's science and technology base. The accumulation of

know how and technology, increases the qualified work force, and may lead to the development of other associated industries, providing the most significant contribution of the defense industry to the national science and technology base.

C. THE DEFENSE SECTOR AND THE ECONOMY

The macro-economic consequences of the defense industry, that is the effect of its existence, and of the changes of the defense industry and defense expenditures in general on the economic performance of a country, has always been a rich topic for studies and discussions.

The establishment of a domestic arms industry can have significant positive economic effects, through spin-offs, the provision of jobs and the development of human capital, the utilization of excess production capacities, and externality effects through the linkages with the rest of the economy. Some studies have highlighted the fact that domestic arms production can have a number of negative effects, such as the crowding out of resources, both investment and human capital, a reduction in civilian technological development, an externality effect on other companies and a reduction in industrial efficiency and international competitiveness.

The critics of the vast scale of defense expenditures have been tempted to look at this factor as a cause of many other economic and social ills. They have argued that the high level of defense expenditures, coupled with a chronically high rate of inflation and rising unemployment, has led to the poor performance of many countries worldwide. They have expressed their concern in terms of relations with defense expenditures and certain economic indicators.

In the first place, the relationship between defense expenditures and inflation has been identified in terms of three outcomes of increased defense expenditures, which are the excess demand, 'bottleneck' inflation and budget deficit. Increased defense expenditures have been identified as the primary cause of excess demand and blamed for leading to inflation in that way. A big rise in defense expenditures can, of course, bring about excess demand in the economy, which subsequently can bring about inflation. The war is the prime example of such a phenomenon. Moreover, a sharp upswing in defense expenditures –particularly if it is concentrated on procurement- can cause some 'bottleneck' inflation [Ref 7, p.10]. This can arise from specific shortages of materials and/or skilled personnel needed for the new weapons programs. Finally, since it is government spending, defense expenditures are a component part of any central government budget deficit. Actually the question if budget deficits inevitably lead to inflation- and if not inevitably,

under what circumstances do they happen, has been an area of controversy. If there is a central government budget deficit, then inevitably military expenditures are a part of that deficit. However, if the economy is at less than full employment (however defined), it cannot be categorically stated that the deficit is necessarily a cause of inflation.

Second, the government's ability to increase employment or decrease unemployment by increasing defense expenditures and expanding the defense industry has been largely debated. In fact the issue has been examined, not in terms of military expenditures alone, but in terms of government expenditures in general. Though those individuals, who have political or economic reasons for wanting to see defense expenditures and arms production receive an important share of state resources, have argued that one result of less defense expenditures, particularly in the form of arms procurement, is higher levels of unemployment, possibly isolated in certain localities. Evidence has been provided that military expenditures are neither a particularly important source of employment in most countries nor the best means of increasing employment [Ref 7, p.10].

Third, the structural consequences of high military spending, whether the course of military spending can explain the general slowdown or upswing in economic growth, has been the focus of

many research studies. The most common argument here is to cite the comparison between Germany and Japan on the one hand, and the United States and Britain on the other. The latter have been low-growth countries with respect to the former. When other countries are brought into the comparison, the apparent relationship between high military expenditures and slow growth becomes clear.

The final economic question concerning defense expenditures is the economic problem, which is posed in times of substantial disarmament. Some countries' economies may find the adjustment to disarmament and the reduction of their defense-industrial sector more difficult than others

After all these discussions, the main point to make about defense expenditures is a very simple one; it uses up resources which might alternatively be employed to provide consumer satisfaction, either in the provision of private or of collective goods and services. In particular, if the skill and ingenuity devoted to weapons development were diverted to civil objectives, the process of technological advancement in the civil field could be appreciably accelerated.

However, except when there are major trends in defense expenditures, it is a mistake to consider that the defense industry is responsible for such macro-economic developments as upswings in prices or unemployment. In particular, the worsening economic

performance in the industrial economies cannot properly be attributed to changes in defense expenditures alone.

D. DEFENSE MARKET

1. Factors Influencing Defense Expenditures

A country's allocation for defense expenditures is sometimes driven by the result of an arbitrary political decision as to how to deal with the threat to its vital national interests. The personnel strength of the armed forces, numbers of weapon platforms, and equipment, as well as other defense components initially rely on military doctrine. This choice, in turn, is usually based on the politicians' or analysts' perception of current and/or expected threats, and their desire to achieve designated goals by projecting the country's military and economic power. The estimated military strength of a potential enemy (if any), the country's geographical neighbors, economic constraints, end of conflicts, forced disarmament (Iraq), and severe political changes must be taken into consideration.

2. Traditional Market Systems

In a traditional market place, the seller of a product takes initiative in developing and producing a product. Funding required for development is obtained from retained earnings or through debt

or equity financing. Buyers then decide to purchase the new product or one offered by a competitor. The market is the interaction between the buyer and the seller. First, if a product does poorly against a competitor, the seller will use this information to lower prices, improve the product, or discontinue it. Secondly, the market serves as a reward and punishment system. Producers who anticipate consumer needs ahead of the competition and are efficient at keeping costs down may receive a better average return. A producer neglecting to adapt to consumer desires or with poor cost control makes below-average profits or suffers losses and may eventually be driven from the market. "Prices are determined by competition, not by costs incurred or determination of a fair level of profit." [Ref 8. p.55]

3. Free Market vs. the Market for Defense Products

In a general sense the defense market is like any other market in that it brings together buyers and sellers. The parties are brought together through a legally binding contract by which the supplier, in return for goods or services, receives payment.

The market for defense products differs from the traditional free market in several aspects. In the weapons market, the buyer decides what he wants developed. The buyer rather than the seller usually finances the weapons. This is accomplished through cost

invoices, loan guarantees, or advance payments. The buyer can supply government-owned property or equipment to further reduce the investment required by the seller. Competition between sellers is not always based solely on the price factor. During the early stages of a weapons acquisition program, competition may be centered on performance or best value while costs may be a secondary concern.

The weapons acquisition market differs in how price is resolved. In a cost-plus-fixed fee or award-fee contract, the price is ascertained by determining costs, and then adding a "fair and reasonable" fee (profit). Even in a negotiated fixed-price arrangement, sellers may have to certify cost data as current, accurate, and complete.

Through market research firms can estimate demand for their products and plan accordingly. The cancellation of a product line is usually an internal corporate decision. In contrast, the market for weapons is subject to annual changes in the budget that may increase, decrease, or eliminate a program due to a policy change (For a more detailed comparison, see Appendix-A).

4. International Market for Military Equipment and Services

After the strong growth during the Cold War era until 1988, with the peak in 1987, the world defense market shrank steadily

until 1996. Since 1996, world military expenditures have been fluctuating. However, behind this fluctuation is a general slight rise in most regions. Total world military expenditures have increased by a 2.1% in real terms and amounted to roughly $780 billion in 1999 [Ref. 9 p.5].

Globally, military expenditures are highly concentrated in a few countries. The 15 major spenders accounted for 80 per cent of the world total in 1999, the USA accounts for 36 per cent, followed by Japan and France with 7 percent each and Germany and the UK with 5 and 4 percent, respectively. The next three in size — China, Italy, and Russia —account for 3 percent each of the world total. The rise in world military expenditures in 1999 is accounted for primarily by a few of these major spending countries, the USA, France, Russia, China, Brazil and Turkey.

Most forecasts point to a renewed growth in defense spending in all regions of the world, although overall growth rates are expected to be moderate, with significant differences between countries.

In the United States and Europe, the defense programs launched during the Cold War are now either in the production phase or just about to move into production. Some current programs could be canceled or postponed. Most of them are expected to go ahead, but often at a slower rate or smaller volume. In addition,

some in-service equipment now needs to be modernized, and this should help to partially support the recovery in defense markets.

In the rest of the world, particularly in the Asian Pacific, certain countries are increasing their defense equipment budgets in line with efforts to consolidate their regional influence. The rise in East Asian military expenditures in 1999 is due primarily to the rise in the Chinese military expenditures. However, there was a reduction in defense spending by the East Asian countries that were affected by the 1997 financial crisis.

Other countries, particularly in Latin America, are facing the need to modernize their defense systems, some of which are now obsolete.

In the Middle East military expenditures decreased in 1998 and 1999, but from a high level. Although most of the Middle Eastern countries belong to the richer countries in the world, most belong to the group with the highest defense burden as measured by the share of military expenditures in Gross Domestic Product (GDP).

The increases in military expenditures in Africa and South Asia add to the already heavy defense burden in many poor countries in these regions. In Africa many countries are involved in armed conflict, either directly, or indirectly.

There is a tendency for procurement expenditures to rise more rapidly than total military expenditures in most countries, mostly for the wish to support the domestic defense industrial bases, which in many arms-producing countries have been significantly reduced during the 1990s due to the declining demand for weapons.

Table II-1.Fifteen Major Spenders: Military Expenditures, 1995-99

Rank	Country	1995	1996	1997	1998	1999	Share (%) of world military expenditure
1	USA	278.9	263.7	262.2	256.1	259.9	36
2	Japan	50.1	51.1	51.3	51.3	51.2	7
3	France	47.8	46.6	46.8	45.5	46.8	7
4	Germany	41.2	40.3	38.9	39.0	39.5	5
5	UK	33.8	34.4	32.3	32.6	31.8	4
6	Italy	19.4	21.4	22.4	23.1	23.5	3
7	Russia	25.7	23.4	24.9	18.1	22.4	3
8	China	12.5	13.7	14.9	16.9	18.4	3
9	South Korea	14.4	15.5	15.6	15.2	15.0	2
10	Saudi Arabia	13.2	13.2	17.9	16.4	14.5	2
11	Brazil	10.9	9.4	11.5	10.9	14.3	2
12	India	8.0	8.2	8.9	9.3	10.2	1
13	Turkey	6.6	7.4	7.7	8.1	9.6	1
14	Taiwan	9.9	10.2	10.5	10.6	9.3	1
15	Spain	8.7	8.5	8.5	8.4	8.7	1

Source: SIPRI Yearbook 2000

E. THE DEFENSE INDUSTRY IN DEVELOPING COUNTRIES

Driven by the desire to reduce the vulnerability inherent in their dependence upon foreign military hardware, and by the hope of economic gain, developing nations have been increasingly involved

in the process of developing their own defense industries. They believe that their domestic weapons programs will put away arms embargoes, interruptions in the flow of spare parts, restrictions on the use and resale of foreign weapons, and suppliers' attempts to influence their foreign and domestic policies firmly in the past.

The developing countries' quest for domestic defense industries has generally followed five stages. At first, prefabricated components have been imported and simply assembled in-country. Second, actual production of weapon components under license agreements with foreign suppliers has taken place. In the third stage, complete foreign-designed weapons have been produced under license. By the fourth stage, national defense industries have gained the ability to modify, redesign, and reproduce foreign weapons, and in the fifth stage they finally have gained the ability to produce domestically designed arms.

Today, developing nations are now producing not only small arms and ammunitions but also sophisticated military aircraft, armored vehicles, naval vessels, and ballistic missiles. As early as 1988, of the 16 Third World countries believed to possess ballistic missiles, 12 were actually developing or producing the weapons themselves [Ref 10. pp.18-19].

The percentage amount of major conventional weapon systems supplied by the developing countries has grown dramatically in the

last four decades and reached a total of 10% during the period of 1986-1997 [Ref 11 pp.15-16].

India, Israel, South Africa, Brazil, Taiwan, North Korea, Argentina, South Korea, and Egypt are the leading defense producers among the developing countries. They are able to design and produce all four types of major conventional weapons, as well as small arms and ammunition. Ten more countries, have started to produce at least two or three of the four types of conventional arms, these countries are: Chile, Colombia, Indonesia, Mexico, Pakistan, the Philippines, Thailand, Romania, Bulgaria, and Turkey.

Although many countries still depend heavily on foreign technology, that form of dependence is less burdensome than depending on imported weapons. Production technology cannot be easily withdrawn, controlled, or manipulated by suppliers. More importantly, technology can be built upon. Defense industries founded upon imported technology are already significantly reducing arms imports in a number of countries.

Despite such progress, Third World countries continue to import arms. But that is true of industrial countries as well. Even the most advanced arms producers such as Great Britain and the United States manufacture some foreign weapons under license, and incorporate imported components into their own weapons systems in collaboration with other countries in weapons development and

manufacture. In a small way, arms procurement patterns in advanced and developing countries may be moving very slightly toward convergence.

F. ARMS PRODUCTION and GENERAL-TRADE TRENDS

Following the sharp decline after 1988, overall world military expenditures have been fluctuating since 1996. Substantial cuts in defense spending have still been the driving factor of the lower demand for defense products, and have been troubling even the superb defense industries with remarkable capabilities and vast capacities.

At the same time, the cost for R&D and manufacturing of weapon systems has increased significantly during the last decade. Since design and development costs are a such big part of the total cost, it has become more important for the defense industry to have long production runs in order to get the benefits of lower development costs per unit and to offer lower prices.

Higher cost and shrinking market have made the problems related to economies of scale more and more emphasized. A reinforcing loop can describe this process: lower budgets, less demand, reduced production, higher costs per unit, less demand, reduced production.

1. Excess Capacity

One obvious result of both lower defense budgets and more expensive systems has been the declining order sizes, which have led to lower production rates and increased time between new systems. Another trend having negative impact on the defense industry output has been the increased emphasis put into the modification of older existing systems, increasing their life and capability as a means to save money [Ref 12.p1].

This has led to more and more defense industries with excess capacity. In the absence of any offsetting action, a reduction in capacity is inevitable.

This collapse in international arms trade is primarily due to the ending of the cold war and a resolution of several Third World conflicts. The traditional arms exporters- the United States, Europe, and the former Soviet Union, must contend with an increasingly competitive global arms market, as new suppliers, particularly in the developing world have emerged [Ref 12. p2].

2. Globalization

In nearly every country, arms production has traditionally been one of the most protected sectors of the national economy. Many countries would prefer to be self-sufficient in arms

procurement and domestic defense industries have generally been perceived as the most secure source for defense equipment. Even in the "capitalistic' countries, weapons production is usually placed outside the boundaries of free market economics. Competition, efficiency, and profitability are secondary to guaranteeing the domestic resources needed for national defense [Ref 12. p.1]. The stable domestic market has been important in supporting the development of new weapons systems both financially and technically.

Today a different trend is emerging, and the defense industry is becoming less and less domestic. This trend is often described with the term "globalization." The term globalization is used as an umbrella for a lot of different activities. Some of the different activities falling into this category are:

- **Co-development**: Transnational design, development, (and production) of weapons systems.
- **Consortium**: A formal but ad hoc industrial agreement to co-develop or co-produce.
- **Family of Weapons**: An international division of labor involving several related weapons systems, where participating countries separately develop a particular weapon within the group and then permit the other participants to produce that weapon for themselves.
- **Joint Venture**: An international company jointly owned and operated by defense firms in two or more countries in order to co-develop and co-produce a weapon system [Ref 12. p6].

Globalization implies that development and co-production of a weapons system is made, at least in part, outside a country's border, and in most cases in cooperation with other nations. This is a big change, and it seems obvious that this trend is going to have implications for a variety of national security issues, including security and defense policy, arms control, regional security cooperation, and the future size, structure, and capabilities of a domestic defense industrial base [Ref 12. p1].

The reasons for globalization can be both military, political, and as mentioned above, economic. The most commonly described are some of the following:

- Sharing costs and by doing so reducing the risk of researching, developing, and manufacturing new weapons systems.
- Gaining access to foreign technologies.
- Helping to achieve economies of scale in the production of increasingly expensive weapon systems.
- Developing and penetrating foreign markets that might otherwise be closed to arms imports.
- Enhancing combat efficiency and effectiveness of military alliances by eliminating wasteful duplication in arms production, while promoting battlefield rationalization, standardization, and inter-operability.
- Fostering other types of international cooperation, such as NATO political solidarity or European integration [Ref 12. P.5].

3. Restructuring

All defense industries have been facing major challenges, which will certainly cause a need for structuring. A move towards

non-military production is one option. Consolidation, concentration in core competencies, and downsizing are other options available. These options can be used alone or together.

Another trend that has been especially visible is the creation of a monopoly of suppliers through mergers and acquisitions. This can be done to reduce the number of competitors, control important resources (skilled workforce, technical edge, access to markets, capital and raw material, etc.) or take over customers. There are many examples where big British, French, German and American defense companies have bought out other producers of defense systems in both Europe and the US. The total size of the industries is reduced, and the power is becoming more concentrated to a few companies, often called National Champions. Some companies have decided to leave the defense market altogether.

Strategic alliances, a loose industrial agreement between defense industries in two or more countries, is also something that has emerged

4. New Competition

As mentioned earlier, the number of countries with developed defense industries has been increasing, and as they become more and more self-sufficient in the production of weapon systems, they are beginning to enter the arms market as exporters.

If this trend continues for another couple of years, some of these countries will not only be able to develop and produce weapon systems with substantial indigenous design, but will pose a serious threat to the established countries on the global arms market [Ref 13,p.148].

5. Other Measures

There are two other trends that must be commented on. The first is that the increased competition forces the defense industries (or in some cases governments) to adopt new pricing policies, in order to get orders for their systems. Finding a way to lower prices is probably a necessity that most defense industries are forced into by the tough competition its industry is facing in the world market.

The other trend is to re-evaluate and relax current export restrictions regarding arms and defense related technologies. This is not something the defense industry itself can do, but it can put political pressure on the government in order to gain access to a closed market. The government may feel a strong pressure, and see relaxed regulations as a quick and simple solution to some of the industries' problems, so they are ready to re-evaluate earlier limitations.

But it is important to remember that new export policies will have to balance the defense industries' economic concerns against

the countries' foreign policy goals such as arms control and non-proliferation. In this regard, some countries may find it necessary to keep the export restrictions on certain types of weapons and military technologies, while at the same time, remove other restrictions that damage the domestic defense industry.

6. Offset

Defense related offset or "compensation" in the form of licensed production, domestic production or guaranteed import of goods from the recipient country, is almost a rule in today's marketplace. The reasons for offset are both economic and political.

One important factor behind a request for offset is the political process. In many democratic countries, there is often a debate between different factions before a decision is made. In order to gain support for a decision to buy a weapons system abroad, the government wants to point out other benefits from the deal. Such benefits can be to license production domestically (creating jobs), and subcontract portions to the domestic industry, or other goals related to industrial policy.

A buyer, primarily in the developed countries, normally has one or more of the following goals when demanding offset:

- Building domestic capital
- Restructuring the industrial base
- Subsidizing a region or an industry

- Supporting its security policy
- Gaining political support for the deal.

Offset is often tied to one single project, but can be spread out over several years. Offset activities can be related or unrelated to the imported system. These activities influence the defense industry in different ways.

A percentage of the total project should be produced in the recipient country. This often makes parts of the defense industry in the recipient country subcontractors to the seller and can lead to abandonment of some of the normal subcontractors in the selling country.

The seller may have to transfer technology, knowledge or capital to the recipient country. This usually involves the defense industry in the recipient country, but not always. The transfer can be unrelated to the imported system. As a rule, many countries want to gain the knowledge and the technology to support the system themselves.

The selling country may promise to buy products from the recipient country for a percentage of the system value. This can in some cases be considered as a "payment," and be totally unrelated to the imported system. This will not affect the defense industry.

As a rule of thumb, offset is almost a must in today's marketplace, and it is up to the recipient to decide how, and where to use it.

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III. TECHNOLOGY TRANSFER

A. THE CONCEPT OF TECHNOLOGY TRANSFER

1. General

The transfer of technology can be defined as the transmission of know-how to suit local conditions both within a country and from one country to another. The term technology indicates the sum of knowledge, experience, and skills necessary for manufacturing products and for establishing an enterprise [Ref 14. p.119].

Before beginning to explain technology transfer, the term technology should be analyzed. To understand technology, current trends in the area of product development and production should be explained. These trends are:

- Innovation is more rapid, resulting in technology and processes that are more widely applicable.
- Shorter life cycles, and more flexibility in response to consumer needs are emphasized.
- Increased automation results in a smaller role for unskilled labor.
- A strong emphasis is placed upon quality products and quality management.

In light of these trends, a wider definition of technology will be that technology is the knowledge, procedural methods, and organizational models used to transform input into high value added, and marketed output. Such a definition stresses knowledge, organizational models, and methods more than physical bulk. The

focus of technology is therefore moved away from physical objects. In this manner technology is embodied in people, their institutions and the management capability of those institutions. The acquisition of technological capability is therefore more a matter of building up skills and institutions.

As a result technology transfer can be described as the process by which technology, knowledge, and information developed in one organization, in one area, for one purpose is applied and used in another organization or area for another purpose.

In any type of technology transfer, the prime objective is to transfer production knowledge from one location to another. This transfer is made in order to undertake specific production activities. Therefore, the amount of output produced is one measure of success. In addition, it is obviously important to examine the efficiency achieved in the new production process. This efficiency examination can be made in terms of materials and energy used, the productivity of labor and machinery, and the relevant norms of best practice elsewhere (some kind of 'Benchmarking').

A technology transfer takes place when a group of people become capable of performing one or more functions attached to a specific technique in satisfactory conditions [Ref 15. p.16].

Technology transfer cannot be separated from technological innovation. Technology transfer is only one aspect of technological

innovation. It can be defined as a purposeful, conscious effort to move technical devices, materials, methods, and information from the point of discovery or development to new users.

In management terms, technology transfer implies the management of change. This change consists of bringing new ideas, knowledge, processes, and products to the attention of the people who may use them.

Technology license is the major form through which technology is transferred between countries. It confers the right to use patented technology for a manufacturer and to communicate related know-how on mutually agreed terms [Ref 14. p.120].

The large outflow of technology has been from the United States mostly because of its large multinational corporations having advanced technologies. At the same time, technology has flowed into the United States, mainly from other Western Countries and Japan.

Technology transfer can help countries:

- Evaluate their technology requirements.
- Solve technical problems.
- Apply different technologies to their specific needs.
- Evaluate and improve their processes.
- Gain expert advice in a whole range of areas.

However, there are some tasks that should be carried out while conducting a technology transfer:

a. Technology Transfer Requires Transition Planning

The most fragile points in the technology transfer process occur during transition planning. The burden of transition planning in technology transfer falls most heavily on the party handing off the technology.

b. Market Knowledge Drives Technical Development

Market analysis justifies movement into commercial technical development. For industry decision-makers in fact, only the market knowledge can justify investment in commercial technical development. Such knowledge includes documentation of user needs, market size, industry keys (market-specific purchasing decision criteria). Three points of product differentiation tied to industry keys, pricing strategy, analysis of best practices and trend forecasts, identification of market barriers, and analysis of competition and substitution options.

c. Technology Transfer Depends On Matched Capabilities

Success in joint R&D ventures, technology licensing and direct technology transfer depends heavily on the "organizational/personal fits" that smooth transition. Successful hand-off occurs when partners complement each other in the following ways: Combined resources should marshal all the capabilities and personnel listed in the innovation process chart. All parties should agree on the thresholds for market size, pricing, and

product placement. The parties should arrange the transition through organizational units of similar scope and scale. All parties should share (or at least understand) the perceptions and assessments of risk, and all parties should agree on priorities and levels of commitment.

d. Industry Drivers Control Industrial Technology Transfer

"Business potential" offers the only acceptable rationale for industrial technical innovation. Market data (not technical data) justifies investment in technology development. Engineering success, field tests, and technology demonstrations can only produce commercial development after filtering through screens of market analysis and calculations of return on investment. Supplementing technical data with market information significantly improves the prospects for direct technology transfer.

e. Technology Transfer Involves Human Barriers

Technical innovation makes changes in work patterns, supplier lists, training needs, customer bases, regulatory requirements, pay scales, and a host of other areas. Such human impact factors can erect major barriers to commercialization of new technology. Human impact and potential human impact barriers require definition and evaluation in the same way as technical development, market analysis, and infrastructure planning.

f. Technology Transfer Must Address Risks

Addressing perceived risks furnishes the single most important task in promoting technical innovation. Market uncertainties pose the most critical risks for industry decision-makers. Market knowledge must justify any investment in commercial technical development. However, no engineering knowledge or technical data can reduce perceived risks that arise from market and business uncertainties.

To evaluate the technology transferred is more difficult than to evaluate the capital inflow. The technology transfer is successful when:

- It is employed effectively in a new environment, even if the whole factory is operated by foreign experts,
- Workers in the host country obtain enough skills to operate the transferred machinery and managers can work out plans for operation and marketing (this is usually the case of joint ventures),
- It produces good effects on other economic concerns,
- Techniques originated from the transferred technology can be developed and improved in order to suit the local economic activities.

Thus, benefits of the technology transfer to the recipient country depend on its suitability and effects on the local economy.

2. Technology Transfer Processes

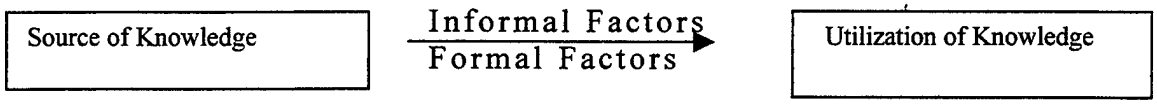
One definition for technology transfer is that it is the process by which existing research is transferred operationally into useful

processes, products, or programs that fulfill actual or potential public or private needs [Ref 16. p.1]. Jolly, Creighton, and George state that the term "research" should be interpreted in its broadest sense to include developments in many fields from Aerospace to Mental Health to education. Their concern is that of taking an existing idea or body of knowledge, from any of these fields, and using it in a different place, in a different way.

a. Simple Process Model

The transfer mechanism represents the interaction of people, and need not be independent, but may be incorporated in either the supplier or user environment [Ref 16. p.2].

The transfer process of knowledge or information could be viewed as the movement of information from source of knowledge to utilization of knowledge. Efficiency of the utilization of knowledge depends on how effective the mechanism is. The transfer mechanism could be further divided into two groups of organizational factors as formal and informal.



(Supplier) Transfer Mechanism (User/Receiver)

Figure 3-1 Simple Process Model

Formal Factors are producers for dissemination of storage indexing and retrieval of knowledge, while the Informal

Factors are interpersonal communications and contacts, personal beliefs and feelings about knowledge source, perceptions about one's organizational supervisors and peers [Ref 16. p.3].

b. *Discussion of Elements of the Model*

(1) Formal Factors. Formal factors are the methods of information documentation, distribution systems, formal organization of the user, and the selection process for projects.

Documentation is the format, specifications, and presentation of the technology or information being transferred. Format and language relate directly to the understanding of the receiver.

The distribution system is the physical channel through which technology flows. It involves the number of entries and the ease of access in to the channel, as well as the formal distribution plan.

Formal organization of the user is the impact the formal organization of the potential technology user has on the transfer effort. Under this factor, we can consider such things as the rules, norms, and role structure of a specific company, business, or governmental agency.

Selection processes for projects refers to the selection process for research and development undertaken by the

source and the receiver's contributions to that process [Ref 16. p.5-7].

(2) Informal Factors. Informal factors are the capacity of the receiver, informal "linkers" in the receiving organization, credibility as viewed by the receiver, the perceived reward to the receiver, and the willingness to be helped.

The capacity of the receiver refers to the ability and capability of the potential user to utilize new ideas.

Informal "linkers" in the receiving organization refer to the presence and the effects of the individuals in the receiving organization who link their organization to the larger environment.

Credibility as viewed by the receiver is the receiver's assessment of the reliability of the information provided to him.

The perceived reward to the receiver is defined as the perceived payback and the social system of which the individual is a member.

Willingness to be helped relates to the individual's ability and/or desire to accept change in the organization in which he is a member [Ref 16. p.9-11].

B. FACTORS AFFECTING THE TECHNOLOGY TRANSFER

1. Economic Factors

Economy is the leading power in today's world. It affects the decisions that would be made about the diffusion and process of technology transfer.

Some countries are economically more advanced than others. This situation causes the economically powerful countries to have the most advanced technologies while the economically less-developed countries do not.

As discussed in "Technology Transfer" by A.C. Samli, there are three key situations regarding the technology transfer:

- The poor countries needs exceed their capability of transferring technology,
- Economically- advanced countries expand the economic gap between themselves and other countries by generating, adopting, and properly utilizing the most up-to-date technology.
- Regardless of the degree of economic development, the economy dictates, to a substantial extent, the appropriateness of the technology to be transferred [Ref 14. p.5].

Regardless of the size and power of the recipient country, there are some non-economic factors affecting the technology transfer. For example, prior technology drag can be a handicap that affects the transfer of technology. A prior technology transfer provides significant benefits because of large and installed bases.

In some cases, investments are irreversible. Adoption of technology requires irreversible investments in areas such as products, training, and accumulated project investments.

Sponsorship can be a sub-factor affecting the technology transfer. A single entity (person, organization, and/or consortium) should exist to define the technology, set standards, and subsidize early adapters. In other words, this sponsor should promote the adoption of the new technology.

There are expectations from a technology transfer. The technology transfer benefits from an extended period of widespread expectations that it would be pervasively adopted in the future.

2. Technical Factors

Technology is the capability of applying science to economic activity or production. Therefore, it should include all the hardware, software, and other supporting activities [Ref 14. p.8].

In this case, there are a number of technical factors that should be taken into account. These are: transportation, infrastructure, communication infrastructure, availability of skilled labor, product counterfeiting, lack of cooperation of partners, cash flow/accounts receivable, trade malpractice, concepts of selling, and lack of openness to processes.

All the factors listed have their importance in the context of their usage. One factor may be important in one context while others may not. Each factor should be considered and studied according to the area where the technology transfer takes place.

3. Political Factors

Governments play important roles when a technology transfer takes place. Every government in the recipient country may itself transfer technology or specify some incentives for technology transfer by the private sector. In either case there are laws, both in the recipient country and in the country that is exporting the technology, concerning and keeping in order the transfer of technology. These laws and the rules specifying the technology transfer affect transfer by making it easy or making it hard.

There are other political factors affecting the technology transfer. These are the issues related to international law and the rules asserted in the charters of the international organizations. These sub-factors can be human rights issues, political stability, and equal opportunity, and profit. Again, as in the case of technical factors, these should be considered in their own context of use.

C. TYPES OF TECHNOLOGY TRANSFER TO FOREIGN COUNTRIES

There are three types of technology transfer to foreign countries. These are Foreign Investment, R&D, and Technology License Agreements and Joint Ventures [Ref 14. p.160]. Most countries need capital as much as they need technology and management know-how. Direct foreign investment appears most attractive to some. This is because direct foreign investment has the characteristics of the other types of technology transfer. In some cases the country may only need some elements of the package.

1. Foreign Investment

The flow of technology to different countries has been an integral part of direct foreign investments. The significant flow of new techniques and processes are made by multinational corporations, which prefer capital-intensive technology. These corporations may invest in other countries in order to protect the existing market, or to create new markets, to bypass prohibitive barriers and import restrictions, to take advantage of cheap labor and skills, and to discover or protect raw material sources.

The issues of transfer of technology and foreign investment are inexplicably linked. Multinational or large foreign firms are investing very large proportions of their resources to the development of new products, technologies and processes. In recent

times, brand names have come to be identified with important and desirable characteristics such as quality and reliability. In some products, the technology is tied into the acquisition of the right to the brand name. Such products, technologies, and processes may be proprietary in nature. For the import of such proprietary technology, joint ventures may be required. If the country profile in international markets is attractive enough, multinationals will look favorably on such joint-venture deals with the domestic private sector.

When a firm enters a developing country to introduce a new product or to manufacture some commodity, it will wish to bring in all that will enhance its profitability, including technical knowledge. However, in order to do so it must be able to rely on the availability of inexpensive or at least affordable domestic technical skills of acceptable quality. The issue of the transfer of technology is tied in with the desire to attract direct foreign investments. But a key link may be the development of domestic human skills in the recipient country.

Many countries have been aware of the costs of the investments by foreign multinational corporations. The outflow of profits and dividends with the fees, royalties to patent companies, and payments for goods and components imported have been of a very high order. There has been a growing feeling in these countries

that ownership and control should be in the hands of the nationals of the country. Consequently, foreign equity holdings are often limited to a certain percentage [Ref 14. p.126].

Policies followed by technology transferring countries with respect to foreign investments have considerable impact on the form of technology acquired. For example, if foreign investments in industry are regulated and local free enterprise exists, technology licensing is increasingly being used.

In many cases a significant degree of foreign capital ownership is a pre-condition for technology transfer. Highly technical processes and techniques may not be available to other countries unless the owner is allowed at least controlling capital ownership of the enterprise [Ref 14. p.126].

2. Research and Development (R&D)

In some cases, countries that want to transfer technology can take part in the R&D projects undertaken by developed countries. This may occur by the participation in the costs and the work that will be carried out.

Some countries, which need technology transfer for their industrial base, undertake R&D in some form, however, they should have well-defined and properly organized institutions for the management and coordination of such work. Research and

Development have been lately recognized as an essential tool for the expansion of the national economy. Most technology transferring countries spend a very small portion of their GNPs on R&D. Nevertheless, it is essential that R&D institutions be properly planned and operated [Ref 14. p.127].

3. Technology License Agreements and Joint Ventures

Direct foreign investments in different countries have generally been in the form of wholly owned subsidiary corporations. However, an increasing number of new investments have been joint ventures involving shared ownership between local and foreign partners. There are various factors contributing to the growth of joint ventures [Ref 14. p.127]. Countries that want to transfer technology may pass legislation either prohibiting total foreign ownership or making incentives provisional upon a certain degree of local ownership. Depending on the overall investment capital in a country and on the size and profitability of the market, foreign investors are becoming increasingly willing to participate in equity capital on a majority basis.

Joint ventures have been defined as a common project between legally and commercially independent companies in which the parties jointly bear both the responsibility for management and the financial risk [Ref 17. p.201]. They are also established as separate

corporations in which the ownership interest is split between two or more partners who, in the typical case, are corporate entities. However, all partners in the joint ventures are exposed to the same risks, although the way in which this responsibility is divided among the partners through their agreement is quite variable.

The motivations for entering into a joint relationship must be strong for success to be assured. Although hard data on joint ventures successes and failures are scarce, the little information that is available suggests that this reputation is well deserved. For example, in the article written by Killing, he surveyed 37 international joint ventures and found that participants rated 36 percent of them as having performed unsatisfactorily, a high proportion indeed [Ref 18. p. 120-127]. In Killing's paper, the percentage of success was higher, but even here 27 percent estimated that the joint venture would not continue in its present form. Of those who saw their joint ventures continuing, one-third conditioned their affirmative answer in one way or another. Clearly, one should not become involved in joint ventures casually.

The reality of global competition today is that few companies possess all of the competitive advantages that would enable them to be successful internationally. For firms in industrialized countries, prospects for future growth are increasingly seen as being disproportionately in developing parts of the world, not in more

familiar markets in the developed nations. But, for a variety of reasons, doing business in developing countries is viewed as being considerably riskier, to be approached with much more caution. Similarly, developing countries' markets are becoming much more open to international competition, providing both opportunities and dangers for domestic companies. To meet these challenges, managers are attempting to position their firms to become more competitive. Thus, from the perspectives of both industrialized and developing countries' companies, the evolving global market calls for change from past competitive practices.

For this reason, many company managers now attempt to complement their firms' strengths through alliances with other companies. These alliances, many of which are joint ventures, represent a complicated process of identifying one's own strengths and weaknesses, setting forth clear strategic directions, and then endeavoring to match these directions with those of another company. In the cases of interest here, these match-ups involve companies from countries with very different income levels. If joint ventures tend to be unstable when carried out within a country, as they seem to be, then one might anticipate that international alliances would be even more fragile.

There are some reasons why the companies from developed regions choose to enter into joint venture relationships with local

companies in developing countries, instead of going it alone. Among the most obvious reasons is the fact that in some countries, investment regulations require a link with a local firm. In many cases, in fact, the regulations have called for foreign companies to limit their participation to minority status. India provides a clear example where foreign firms were required to be minority partners in a joint venture if they were to invest at all. For foreign companies that saw India as a potentially attractive market, investment as a minority joint venture partner was the only alternative to attempting to import over substantial barriers. Subsequently, this restriction has been relaxed, and many foreign companies have moved to become at least controlling partners in the joint ventures. There are, however, many other motivating factors that tempt company managers to seek joint venture partners.

a. ***Cost And Risk Sharing***

Even corporate managers with extensive international experience often see developing countries markets as inherently more risky than operations elsewhere in the world. These perceived risks, of course, are offset by prospects for long-term profit opportunities in those wider markets, typically a primary reason for investing in the first place. Still, joint ventures provide a mechanism through which companies can limit their financial

exposure while at the same time gaining knowledge and experience in a new market.

b. ***Lack of Country Familiarity***

For a foreign company seeking to deepen its understanding of local conditions in a country, a joint venture provides one way to shorten, what could be a lengthy and potentially expensive process. The lack of knowledge has several dimensions for all the participants; a local partner might be expected to make a contribution, pertaining to local product markets and distribution channel familiarity, knowledge of labor conditions, potential problems in managing the local environment, knowledge of the legal system, government regulations, and familiarity with local customs and conventions.

c. ***Lack of Relevant Contacts Within the Government and Elsewhere***

Depending on the developing country, the ability to navigate expeditiously through government bureaucracies can be critical to an enterprise's success. In the typical case, companies from industrialized countries cannot be expected to have any facility in such an activity, and they look to joint venture partners to provide guidance and expertise.

d. ***Existing Facilities***

Local companies often have existing production and distribution facilities that can be of use to the joint ventures. Ford

in India provides an example, where the company has teamed up with Mahindra and Mahindra to produce vehicles and will use an existing Mahindra facility for start-up production. Local partners can provide a variety of such advantages. Some companies, for instance, have been successful in building established and well-known brand names, which are sold through already developed distribution channels. Without these facilities, a foreign company hoping to produce and sell locally would be faced with substantially higher costs and, possibly, much greater uncertainty.

From the developing country side, it should not be surprising that the motivations for entering into a joint venture agreement are, on the whole, quite different. After all, in considering the possibility of a joint venture, company managers look for complementary areas with their existing operations. And for ways in which the hoped-for partner can provide attributes that are missing or are weak at home. One motivation is the desire to diversify by the financing of a joint enterprise. There are a number of other contributions that motivate developing countries firms to form joint ventures.

e. ***Access to Technology***

Technology availability is the single most important contribution by industrialized countries companies to the joint

venture. Because of this attribute of the developed countries, developing countries tend to form joint ventures.

f. *Access to Management Know-How*

It is a general feeling in developing countries that management techniques need substantial upgrading. Joint ventures are seen as a vehicle for importing knowledge pertaining to organization, strategy formulation, and implementation, marketing, manufacturing, and other management functions. The hope is that this knowledge can be learned and transferred to other local operations. Yet, typical joint ventures in developing countries tend to split management functions, with the general manager's position more often than not going to a local. The reason for this tendency is the cost of maintaining foreign managers abroad, which from a joint ventures point of view can be seen as very expensive. Another reason is that, there may be much to be learned from local managers. It is important that they learn about local customs and mores. Thus, the actual appointment of joint venture managers represents a balancing of financial and cultural interests.

g. *Access to Export Markets*

Joint ventures are often seen by the other partner as a convenient vehicle to open export markets. Although this motivation does not account for all the motivation of the developing countries, it nonetheless accounts for an important part of the motivation as

seen in the implication in the importance attached to the foreign company's international reputation in the relationship. However, many joint ventures are formed explicitly to do business in the local market, not in exporting. Only about half of the joint venture companies are expected to export more than 20 percent of their output. In fact, in many joint venture agreements, exporting has been severely restricted, a condition often set by the industrial country's partner.

However, joint ventures tend to have difficulties, first, in coming up with a mutually satisfactory agreement and then joining together in operations. Operational difficulties can come from a wide variety of sources, some predictable at the time of the joint venture agreement, others unpredictable. Some of the difficulties are as follows.

h. ***Problems Related with Multi-Nationality***

One major problem of multi-nationality is the issue of export rights. Exporting sometimes represents a fundamental difference between industrialized and developing country partners. It is an issue difficult to reconcile satisfactorily. For most of the joint ventures, the industrialized country-company is a multinational corporation with operations and sales in a variety of countries. Typically, it will not want to allow the joint venture to be free to export products into markets that may already be served from

other manufacturing point in the system. The industrialized country-company looks upon the joint venture as one piece of a complex global web, and it does not allow that single piece to dictate its own policies. The rule in such situations is to put strict limitations on the rights of the joint venture to export.

The developing country partner, on the other hand, has much different ideas. The expectation is that as new technology is brought in and product and process technologies are absorbed by the joint venture, exports might provide a natural market for expansion. Indeed, increased exports might be a primary reason for the developing country to have entered into a joint venture agreement in the first place.

One other issue that causes problems is the tax issue. Industrialized country-companies cover tax burdens that it wishes to minimize by the optimization process undertaken by the joint venture. Such tax minimization strategy can affect relations with the joint venture. Particularly when the joint venture either imports parts and components from the industrialized country-company or exports products through the parent company. The industrialized country-company would be very aware of transfer prices between joint venture and parent, and may attempt to manipulate the price to lower its taxes. For example, if taxes are higher in the joint venture's country of operation than in the industrialized country-

company's source country, then there would be a temptation for the industrial country-company to raise transfer prices to lower profits in the joint venture.

i. *Ownership and Control Problems*

Although the negotiations often provide tense moments and the disparate size and interests of the partners can cause difficulties, the major problems come over the longer term of the joint venture operations. The reasons for such problems are various, and the ones that will be explained are those problems that seem to arise repetitively among joint ventures.

The desire of having the operational management of the joint venture independent of either partner is one problem that arises in negotiating joint venture agreements. When the joint venture is not established in a way that will allow for independence, one can expect that relationship problems will emerge fairly quickly. Often this happens when the industrialized country partner desires to limit the joint ventures operations in such a way that would make it roughly equivalent to a completely owned subsidiary. Unless such an arrangement has been agreed to early on, it will cause nearly inevitable problems between the partners later in the joint ventures life.

The other problem is the issue of control. This problem is related to ownership problems, but in some ways it is quite

distinctive. There are a series of difficulties that can occur in managing the enterprise. Mentioned here are only a few of those problems that happen most in joint ventures.

Product line disputes are among the more common of these problems. These generally arise because of the changes of the conditions that existed when the joint venture was formed. Because of these changes, the perspectives of one or the other partner changes as well. As an example, a major appliance-producing joint venture might start out manufacturing small refrigerators and as time goes on, sees opportunities in other appliances, such as cooking ranges or clothes washers. However, the industrial country partner might not agree that beginning such production is within the long-range objectives of the joint venture. The industrial country partner may wish to limit the joint venture to only a narrow line of products.

Another common source of disagreement is related to the sourcing of raw materials, parts, or components. In this case, the joint venture agreement can specify in detail that certain materials be sourced from the industrialized country partner. Aside from the transfer pricing issues that such sourcing raises, the original conditions that made the sourcing provision in the agreement seem logical can change. Over time and as economic development takes place, local sources may become available which would possibly be

lower in cost and at least as high in quality. These sources obviously would be attractive to the joint venture's management. But, the industrialized country partner's view could be different, because it could benefit more from retaining the original agreement and continuing to produce the materials for the joint venture.

Similar disagreements take place in technology utilization. The joint venture might be contractually obliged to obtain all process (or product) technologies from the industrial country partner, a condition that probably appeared innocuous at the beginning. Yet, as operations continue, other sources of technology become available, some of which may be superior to the industrialized country's. Clearly, the interests of the industrialized country partner in such situations may not be identical to those of the joint venture or for that matter, of the developing country partner.

Another technology-related problem sometimes occurs when the joint venture management partner believes that the industrialized country-company is not providing the joint venture with the latest or most appropriate technologies. The industrial country partner, of course, may have good reasons from its own perspectives for restricting technical information. Still, from the joint ventures viewpoint, restricting technologies is equal to treating the joint venture as a "poor cousin," and there are always

suspicions about the motivations of the action. This is particularly true, when the joint venture management finds out that it is not receiving the latest data.

There are also some cultural problems that arise when a joint venture is established. Partly, the problems are due to the obvious fact that the two (or more) partners come from different cultural backgrounds, and individuals may see the same set of circumstances in quite different perspectives. But, there are other dimensions to this cultural gap that are important as well. Corporations themselves have "cultures" which condition how people view their environment and how they interpret issues. This factor is one of the primary reasons why joint ventures established between industrial partners from the same country and even the same industry often run into trouble.

j. ***Problems Related With the Dynamic Changes in the Relationship***

Joint ventures are exposed to a changing panorama of forces that shape and direct outcomes. The changing environment within which the joint venture operates also alters the partners' relationship in ways which can sometimes cause stresses that are difficult, and at times impossible, to resolve.

D. METHODS FOR TECHNOLOGY TRANSFER

The transfer of technology can take on different forms, depending on the kind of technological assistance needed. Technology can be transferred through four kinds of methods. These methods are Employment of Individual Foreign Experts, Arrangements for Supply of Machinery, Technology License Agreements, and Technological Expertise and Assistance in Different Stages of Project Implementation. A combination of two or more of these methods is often used, resulting in a transfer of composite technology [Ref 14. p.165].

1. Employment of Individual Foreign Experts

This device is used quite often. If a competent individual expert can be found, he or she will transfer technology at a relatively low cost (nowadays, China's announcement that it will launch a spacecraft is referenced to its use of Russian experts). Enterprises in different countries have been acquiring simple and unpatented manufacturing techniques and processes by employing an individual expert. This method is suitable only for small-scale and medium-sized projects in various industries.

2. Arrangements for Supply of Machinery

Contracts for the supply of machinery and equipment normally provide for the transfer of operational technology pertaining to such

equipment. This is adequate for manufacturing purposes, not only in small-scale projects but in large-scale industries as well.

3. Technology License Agreements

Licensing is basically the transfer of less-than-full rights in intellectual property to a third party, to permit the third party to use the intellectual property. From a business point of view, you might think of intellectual property as real property, like real estate or a car. You can buy or sell, lease or rent, or otherwise transfer between parties. The rights to use and exploit intellectual property can and do move between business entities. Most often, intellectual property is transferred through licenses and contracts.

The issuance of a license provides the licensee with the right to use the technology within the negotiated fields of use, and protection from infringement by other users if an exclusive license is granted.

Licensing agreements are negotiated between parties and can be tailored to meet the needs of both parties. Licensing agreements may be exclusive or non-exclusive.

Non-exclusive licenses are offered so multiple parties can be granted the rights to use the same intellectual property. Most commercially available software licenses, for example, are granted on a non-exclusive basis. Non-exclusive licenses are generally

granted when the technology does not involve a great deal of further investment on the part of the licensee. The cost of a non-exclusive license is often substantially lower than the cost of an exclusive license.

With an exclusive license, a party is given exclusive access to a particular intellectual property. Generally, an exclusive license is granted where substantial investment is required on the part of the investor to bring the product to market. Exclusivity can be limited in a variety of ways, however. Often an exclusive license is granted for a particular field of use or geographical area, for a limited period of time, or for US. or foreign usage. This allows the licenser to provide needed exclusivity to multiple licensees.

Licensing covers permissions that are granted for the use of patents, technology, and trademarks, regardless of whether an equity relationship exists between the licensee and licensor. Licensing is the most versatile as it offers flexibility in choice and opportunities for the source firm and the receiving institution.

Technology agreements enable a foreign licensor to reap substantial returns in the form of fees, royalties, and profits from the sales of components and intermediate products. In such cases, the developing country should carefully consider the provision of the technology agreement to ensure that the acquired technology is appropriate to its requirements.

Entrepreneurs in developing countries who want to acquire foreign technology must approach the foreign manufacturer when the manufacturing technology is covered by patents or is held confidentially.

4. Technological Expertise and Assistance in Different Stages of Project Implementation (Turnkey Contracts)

In turnkey contracts, one party of the technology transfer is responsible for setting up a plant and putting it into operation [Ref 14. p.131]. Sometimes the recipient country or company wants to acquire new technologies by dealing with only one contractor. In this case, especially in constructing and implementing a new factory in the areas of petro-chemistry or the steel industry, the recipient of the new technology wants to deal with only one contractor.

Turnkey contracts may be easy and useful for receiving parties; however, they are not cheap. As a result, most of the countries transferring technology have been using technology-licensing agreements to save money, which is already a constraint for them.

E. ADVANTAGES AND DISADVANTAGES OF THE TECHNOLOGY TRANSFER

There are many arguments in both developed and other countries regarding the benefits and liabilities of the technology

transfer. One basic argument is that the transfer of technology is beneficial for both of the parties involved. However, there are some benefits and liabilities that should be considered while conducting a technology transfer.

One benefit of the technology transfer is to prolong the life cycle of products that are becoming obsolete in the countries transferring the technology. Moreover, companies in countries transferring technology find new, growing markets. Additionally, companies in technology transferring countries can exploit the low wage rates in the less developed recipient countries.

However, one can argue that national interests in the recipient countries should be protected, so the transfer of technology should be restricted. Their claim is that in the long term, the technology transfer's effect is negative rather than positive. The technology transfer towards the recipient countries may damage domestic industries and cause unemployment. Moreover, the technology transfer causes the recipient countries to be dependent on the countries transferring the technology.

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IV. TRANSFER OF MILITARY TECHNOLOGY

Most of the military technology transfer takes place between the developed and developing countries. In these transactions, the nature of the military technology transfer causes the technology-transferring party to be generally a developing country. Because of the nature of this military technology transfer, this chapter, will discuss the transfer of military technology from developed towards developing countries.

A. THEORETICAL MODEL OF THE MILITARY TECHNOLOGY TRANSFER

Deger [Ref 19. p.142-179] has introduced a theoretical model to explain the military technology transfer for developing countries.

In Figure 4.1, there is a military technology where the output of arms (D) is produced by two factors: capital (K) and labor (L). It is assumed that prior to technical change there is a high possibility of substitution between K and L. Therefore, a widely different range of capital-labor ratios can produce D. The usual shaped isoquant AB in Figure 3 represents current technology.

If the technology is freely available, then a developed country with higher capital endowments will choose to produce output at Ed with the slope of CD. The factors will be Kd and Ld. However, an undeveloped country would choose to produce at point Eu. It has

less capital and cheaper labor than the developed country. Now undeveloped countries would use Ku and Lu.

Given the sophistication and the costs of military research, most of the technological progress takes place in developed countries. Therefore, when technology is induced in developed countries, they work to move it out to the production frontier around the point at which they are currently located. In the model, there would be no possibility of substitution between factors. Innovations come from the economies where the wage rates are high. Therefore, it is expected that the summit of the isoquant be at point Eu, which is the most efficient point. Thus, the technology would be useful for the country having low labor but high capital. The total effect of developed country-induced innovation and the shrinking of the substitution possibility gives a new isoquant of the type GEdH [Ref 19. p.178]. It is obvious that this new technology is not appropriate for developing countries.

In order to use technology most efficiently, a developing country would either discard labor (therefore create unemployment) or at Lu, increase capital to reach the optimum point of the isoquants. Clearly, inappropriate technology is the nuisance of developing countries. This is especially true in military technology where technical progress is faster.

It may be optimal for developing countries to choose the most efficient technology from a purely efficient point of view. However, increasing expenditures in new technologies might cause the increasing obsolescence of the military technology, therefore causing the costs to increase and at the same time, the macroeconomic costs should be considered. As a result, the military technology transfer may have beneficial effects, although the costs will be high.

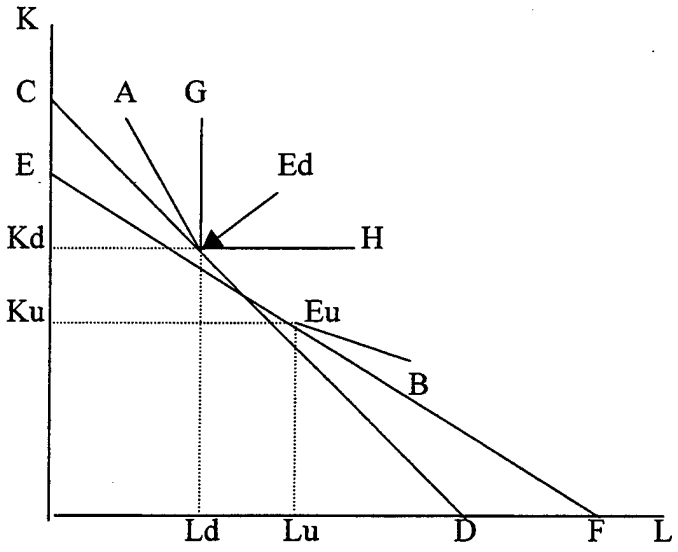

Figure IV-1: Theoretical Model of Military Technology Transfer

Source: Saadet Deger, Military Expenditure in Third World Countries: The Economic Effects

B. REASONS FOR MILITARY TECHNOLOGY TRANSFER

There are three reasons why a developing country wants to transfer military technology. These are:

- The Desire of Domestic Arms Production
- Economic Factors
- Technological Characteristics of the Arms Production

1. The Desire of Domestic Arms Production

Developing countries account for a significant part of the world's conventional weapons market in international trade. Most of the developing countries order and buy billions of dollars worth of ammunition and weapon systems from arms producers. These weapons systems include tanks, self-propelled cannons, armored personnel carriers, combat aircraft, and surface-to- air missiles.

Although these arms transfers from developed countries to developing countries result in an important transfer of military technology in the form of hardware, there is a decline in these types of purchases. The reason for this decline is the desire to produce arms domestically in the developing countries.

This desire to produce arms and weapons domestically leads to an increase in the annual value of the production of weapon systems in the developing countries. However, most developing countries continue to rely on the developed countries' sophisticated military systems, due to the lack of domestic manufacturing capabilities. In the end, developing countries have generally become relatively self-

sufficient only in small arms and ammunition [Ref 20. p.1267]. As a result of this situation there is a shift from direct arms sales to military technology transfer such as blueprints and technical information to produce arms in the name of self-sufficiency. It is not totally possible to achieve self-sufficiency in arms production in developing countries given the fact that these countries need capital and technical efficiency that they do not have for production.

Domestic arms production is motivated by several factors; among the most noted is the desire to reduce the dependency on foreign arms suppliers. This fact has been especially seen for Turkey since the Cyprus Peace Intervention. The intervention there had been sanctions against Turkey by arms-supplying countries. The result has been increased efforts to establish a domestic defense industry that will be self-sufficient for Turkey.

Despite the efforts made by developing countries to build their own defense industry and to be self-sufficient in domestic arms production, they lack the important parts of military technology such as blueprints, specialized machinery, and parts from developed countries in military technology.

2. Economic Factors

One other motive for military technology transfer is the benefit of self-production that will affect the economies of the developing countries.

Investing and creating technologically advanced weapons in developing countries could help develop the national infrastructure that will help civilian sectors. Building a national infrastructure and producing weapons helps developing countries to compete in the international markets for arms sales. The South African Republic, after the 1980s, Turkey, after the 1990s, and especially Israel, after the 1970s are vivid examples for this type of competition.

Moreover, investing in new technologies and developing an arms production sector to help developing countries reach their macroeconomic goals by increasing employment and causing them to evolve new helping side-sectors in civilian markets for military arms production.

3. Technological Characteristics of Arms Production

Developing countries that are in the process of establishing arms-producing centers, feel the need for transferring military technology from developed countries. These establishments have certain characteristics [Ref 21. p.218]:

- Steadily increasing military R&D results in more complex weapon systems,
- A rising rate of weapon innovation leads to rapid technological obsolescence,
- Increasing complexity of weapon systems reduces the probability of copying and allows for effective control of the technology by the producer.

C. SOURCES OF MILITARY TECHNOLOGY

There are a small number of countries dominating the sale of military technology for major and sophisticated weapon systems. The United States, the United Kingdom, France, Germany, Russia, Israel and South Africa account for almost 90 percent of the military technology sold to developing countries in 1997 [Ref 11. p. 11].

Licensed production is the clearest evidence of military technology transfer. With respect to the number of production licenses granted, The USA is the most diversified supplier. The main recipients of the USA military technology are South Korea and Taiwan.

Most licenses are for aircraft production technology. The USA and France dominate this segment of military technology sales.

D. THE VINTAGE OF TRANSFERRED MILITARY TECHNOLOGY

There is a time lag between military design and military production. This time lag can be a relatively good measure of the technological level of the arms production process in developing countries. One measure that can be used instead of the time lag is the vintage of the technology being used [Ref 23. p.23].

Transferred technologies may be from different vintages and newer and obsolete technologies may be used side by side. Under

license agreements. This vintage gap neither increases, nor decreases. However, there may be differences if technological sophistication differs between types of technologies. If simple military technologies are under consideration, the vintage gap may be very short. However, if the complexity of the technology increases, vintage gap also increases.

If the strategic efficiency is under consideration while deciding the sophistication of the military technology, the transfer of highly complex technologies may be optimal for developing countries. However, these technology-transferring countries should take into account the high cost of sophisticated and newer technologies.

E. MEASURES RELATED TO THE CONTROL OF MILITARY TECHNOLOGY

There are a number of control measures for the transfer of international arms and military technology. These control measures can be divided into three categories such as unilateral, bilateral, and multilateral [Ref 24. p.91-92].

1. Unilateral Measures

Unilateral measures occur only when there is a monopoly in arms sales in the international market. These measures are one country's (monopoly on arms sales) restriction and slowing down arms sales and aid for foreign countries.

Unilateral export controls are done by unilateral export restraints for restricting arms sales to foreign countries. Import controls are done by unilateral decisions to restrict imports from other countries.

2. Bilateral Measures

If there are two suppliers of any type of arms in the international market and these suppliers decide to control the weapon sales they export, then there is a bilateral measure to control arms sales. There may be a bilateral agreement between these two countries to control the export and import of the arms trade. These kinds of control measures are more effective, if these two countries account for a substantial amount of arms trade in any kind of weapons market.

3. Multilateral Measures

Multilateral measures are two kinds. Governments carry out one kind, and the other kind is carried out by international organizations.

The measures are the same however, either the governments or the international organizations may decide to impose these measures on arms sales. For example, multilateral restrictions may apply through regional agreements to restrict or abolish the outflow of arms out of the region [Ref 24. p. 92].

F. STRATEGIES FOR MILITARY TECHNOLOGY TRANSFER

There are two major strategies for the transfer of military technology: Path strategy and engineering strategy [Ref 22. p.3-4].

1. Path Strategy

In this strategy, military technology transfer passes through six suggested steps. These are the learning steps that can be considered in the transfer of military technology. Countries may be at different steps depending on their usage of technology. For example, Turkey is more dependent on foreign technology for fighter-bomber production than on shipbuilding. The steps that can be considered are:

- Maintenance and repair of transferred systems,
- Assembly of subsystems from imported components,
- Final production of the weapon systems and production of basic components,
- Production using imported design,
- The capability to design weapon systems domestically,
- Production based on local research and the design of new systems.

a. Maintenance and Repair of Transferred Systems

In this step, recipient countries develop their maintenance capabilities about technologies they transfer from other countries. These countries must learn how to fix, maintain, and rebuild the foreign equipment. Civilian sectors can be helpful by transferring this type of information. Otherwise, foreign suppliers

may provide these skills either to develop them domestically or to control the technologies they export.

b. Assembly of Subsystems From Imported Components

In this step, technology-transferring countries can assemble subsystems that they import from other countries. These countries have the capability of assembling manufactured parts imported from major suppliers. Licensed assembly in military production is dependent upon foreign design and foreign parts.

c. Final Production of the Weapon Systems and Production of Basic Components

The recipient country can provide final assembly of the weapon systems as well as the production of basic components of a weapon system designed by a foreign supplier. In this step, the recipient country needs foreign assistance for the establishment of organizations and facilities needed to assemble or produce.

d. Production Using Imported Design

Domestic arms production starts in this step by using the imported weapon designs from supplier countries. Recipient countries can produce weapon systems by using the reverse engineering process of foreign weapons. Technology-transferring countries can develop engineering abilities to modify the technology designed by a supplier. With the help of the developed engineering

ability, production knowledge, and foreign design assistance, technology transferring countries can produce weapon systems.

e. The Capability to Design Weapon Systems Domestically

In this step, it is assumed that the technology-transferring countries have the knowledge and the ability to produce major components of a weapons system. There is minimal dependence on foreign suppliers for design, organizational knowledge, technical skills, and components of the weapon system. However, the recipient countries need critical technical and organizational skills for the weapons system to be fully assembled.

f. Production Based on Local Research and Design of New Systems

Technology-transferring countries can not only design, but manufacture weapon systems using domestic components and resources. In this stage, the true self-dependency in arms production can be viewed. For recipients of technology transfer, this may be the ultimate goal of the military technology transfer process.

2. Engineering Strategy

There is a dominant view in military technology-transferring countries that they should be self-sufficient at the end of the technology transfer process of military equipment. However, there

are reasons that may undermine the path strategy, especially with respect to the last steps [Ref 25. p.283].

First, development in military technology is so fast that keeping up with the changes through research and development efforts is a heavy burden, even for many developed countries. This high rate of change in military technology leads to the technological obsolescence in military products. Technological obsolescence requires the countries to make frequent improvements in their military technology and equipment in order to compete with the other countries in deterrence. As a result, the problem of import substitution occurs.

Increase in the sophistication of the imported know-how and materials cause an increased dependence on the exporting country. Efforts trying to decrease this dependency lead to an increase in the costs of arms production.

Secondly, the goal of self-sufficiency in arms production has lost its allure during the past forty years. This situation is also true for most of the developed, military technology exporting countries. With the help of developing information technology and the globalization of economies there is a highly competitive market for all goods including military weapons. As a result, being dependent from one aspect to another is unavoidable for most of the countries.

Therefore, after applying path strategy to create an industrial and technological base, a developing country may replace the path strategy with engineering strategy. There are two types of engineering strategy: add-on engineering and add-up engineering.

Add-on engineering refers to the adaptation of an existing weapons system to specific needs by changing components, adding features, or taking them away, while trying to incorporate as many domestic parts as possible [Ref 26. p.206]. It is an updating, and improving of existing military technologies.

There are some examples with this kind of engineering strategy. The South African Republic produced the Eland armored cars by improving and upgrading the French AML vehicles. Moreover, Israel's combat aircraft Kfir and Nesher are a result of the use of this strategy with the help of the French Mirage blueprints.

The other engineering strategy is add-up engineering. It is more demanding in terms of technical know-how and previous production experience. The idea behind this strategy is to increase the sources of supply from throughout the world and to integrate the imported components into new and well-functioning weapon systems [Ref 26. p.284].

G. CHANNELS OF MILITARY TECHNOLOGY TRANSFER

In the literature about military technology transfer, the channels of technology transfer have been classified according to different criteria. For the purpose of this study, we have classified them according to the degree of participation of the recipient country in the transfer process. We take into account the existence of a continuous relationship over time, involving a certain level of division of labor and risk sharing between the supplier and the recipient countries. According to this criteria, military technology transfer channels can be classified under five categories.

- Offsets
- Licensed production agreements
- Co-production agreements
- Joint venture agreements
- Foreign design assistance

Other channels of military technology transfer will not be separately discussed here. There are three reasons for this decision: first, channels such as training, education, and consulting are included under the headings of the channels that will be discussed. Secondly, as a result of economic considerations, military assistance programs are no longer as important as transfer channels of military technology.

Although military technology transfer has beneficial effects, the costs are extremely high. In order to lessen the outflow of

foreign currency required, some arrangements have to be made. The term "offset" is used, in this study, as a generic word to refer to all compensatory arrangements practiced in the transfer of military technology [Ref 27. p.130-135]. Therefore, each of the above mentioned channels may be thought of as a direct offset. Moreover, these mechanisms are not mutually exclusive and military technology transfer agreements may incorporate elements from each of them. In fact in literature the terms offset, co-production, licensed production, joint venture, and foreign assistance are used interchangeably [Ref 28. p.183-185]. For instance, the Turkish offset agreement with General Dynamics was a joint venture in nature, but it constituted the co-production of the F-16 C/D combat aircraft.

While licensed production, co-production, joint venture and foreign design assistance agreements, explicitly detail the transferring of military technology to the recipient country, other major offset types, subcontracting and counter-trade may not. The latter two are less likely to encourage the technological advancement of the recipient country. Therefore, in this study only the former four types of offsets are discussed as channels of military technology transfer.

1. Offsets

Offsets are commercial transactions in which the buyer demands, as a condition of the sale, that the seller compensate the buyer through a variety of non-monetary means [Ref 29. p.175].

According to the US Department of Defense, the first military offset program authorized the co-production of the F-104 aircraft and HAWK air defense system in Europe. Over time, the demand for military offsets that began in the developed countries such as NATO, Japan, Australia, and Switzerland spread to the developing nations, Korea, Israel, Taiwan, Singapore, India, Pakistan, Thailand, Argentina, Philippines, Brazil, and Turkey [Ref 30. p.21].

The existence of military offset programs stems from the inelastic demand for military hardware among governments, and the need to purchase equipment abroad, with the high prices of these goods [Ref 30. p.21]. In order to maintain and exercise their sovereignty, governments felt the need to have a standing military force that is prepared to defend the integrity of its borders.

Most developing countries do not have economies large enough to support each country's arms industry needed to satisfy the demand for defense. Therefore, offsets are used for the targeted development of the military industry and the enhancement of domestic capabilities by the purchasing countries that are facing exchange earnings.

Offsets may include [Ref 27. p. 132]:

- The transfer of military technology
- Subcontracting in the purchasing country for components and parts for the weapon
- The authority to market the weapon on behalf of the supplier
- Repair and maintenance contracts for weapons and imports of other industrial goods from the recipient by the supplying country.

In offset arrangements, the offset is customarily split into two groups, direct and indirect. Direct offsets are those which are directly related to the product purchased such as its components. On the other hand, indirect offsets are contractual arrangements that involve goods and services unrelated to the exports referenced in the sales agreement [Ref 28. p. 185].

The sale of F-16 C/D fighters to Turkey has presented a classic case study in the way offsets work and the advantages to each party. The Turkish F-16s would be produced in part by a jointly owned aircraft manufacturing plant built in Turkey by a Turkish aerospace firm and by General Dynamics. It initially co-produced 124 General Dynamics F-16 combat aircraft. The total value of the project was $4.2 billion, $3 billion was provided by FMS credit and the balance by the Turkish government.

The direct offset commitment included the establishment of a joint venture manufacturing plant to assemble the F-16 and to produce its components. General Dynamics and its major sub-

contractor, General Electric, were to aid the capitalization of the plant by the provision of 49% of the funds required, worth $34 million. As a part of this agreement, General Dynamics undertook to export any excess component production from the Turkish plant [Ref 31. p. 3-7].

This is an example of a direct offset, similar to arrangements made between the U.S. and European firms in NATO for a number of years during the 1980s and the 1990s. The aircraft or important sub-systems of it were jointly manufactured in the buyer's country to help offset the cost of the purchase by providing employment, technology transfer, and investment in new plants and equipment. Thus, Turkey would literally acquire an aircraft industry in addition to some extent of technology.

The other aspect of the agreement was the indirect offset commitment agreed to by General Dynamics, of $1.27 billion. This would be achieved within 10 years. Otherwise the company would have to pay a 1.5 % non-fulfillment penalty [Ref 32. p.169].

The indirect offset commitment was split into two categories. Group 1, which included capital investment, joint ventures, and technology transfer, was to account for 10% of the total. Group 2, which included the purchase for export of Turkish goods and services accounted for 90% of the commitment.

General Dynamics was responsible for marketing a complex list of Turkish products including tourism, power projects, and marble. Wasting efforts and resources on a low cost venture would not significantly reduce the offset commitments. Thus, General Dynamics is in the business of economic development. It plans, designs, develops, and finances a product, industry, or real estate development that provides Turkey with the cash to pay General Dynamics for its product. The multiplier effect on both the seller and the buyer are of great potential. This effect creates a situation in which the ideas, technology, and marketing skills of a U.S. defense contractor are placed at the service of a developing country that has little of these and in many cases neither the means nor influence to obtain them readily. The result may be an unexpected arrangement of mutual advantage.

For the purchasing country offset arrangements bring important benefits: they lessen the outflow of foreign currency, maintain or create domestic employment, lead to the acquisition of modern technology, create service capability for high technology equipment, and assist in local economic development. It is clear that it serves the interests of the supplier country by creating a healthy inter-dependence on its weaponry, increasing its exports and promoting ties between the supplier and the purchasing countries [Ref 33. p. 10].

2. Licensed Production

A license is commonly used to describe situations, where the owner of a certain statutory right in technology, grants permission to another party to exercise some of those exclusive rights held by the owner of the technology [Ref 34. p.28].

Licensing agreements generally include a series of provisions regulating the rights of the recipient with regard to the use of the technology [Ref 35. p.30]. The oldest method of international production of weapon systems that were developed in another country is the bilateral licensing agreement [Ref 36. p. 4-14].

Moreover, these agreements have become very common in the international transfer of military technology, both among developed countries and between developed and developing countries. A highly competitive arms market has stimulated these agreements, because many arms receivers usually prefer license purchases as a channel of the military technology transfer [Ref 37. p.15].

The United States is the primary distributor of military technology by using licensed production. While the United Kingdom, France, Germany, and Russia actively provide licenses to developing nations, they do not do so at a level equal to the United States.

The United Kingdom, France, Germany, and Russia are the remaining basic suppliers for different major weapon systems to different developing recipients using licensed production.

There are some suppliers of licenses to developing countries, of which the suppliers themselves are often categorized as developing nations. Brazil, Israel, and China are categorized as developing nations themselves supplying arms systems by using licensed production.

Quite instructive is the competition among suppliers. While the U.S.A. is again the primary supplier of production licenses, it should be noted that eight nations having the same technology provide similar licenses. Significant competition exists among armored personnel carriers, fast attack craft, transport aircraft, helicopters, frigates, submarines and anti-tank missiles. In short, we can say that there are basically three types of military technology suppliers competing in the developing countries:

- The major suppliers include the United States of America, Great Britain, France, and Germany, and Russia
- Second type of competitors include Italy, Switzerland and Israel
- Austria, Spain, Brazil, China and Sweden are minor suppliers of military technology.

There are different numbers of licenses for various equipment categories held by developing world nations. Developing countries most commonly produce the aircraft systems under license. Then

come the agreements to produce helicopters, fighters, and trainer agreements, transport aircraft agreements, light plane agreements, and counter-insurgency aircraft agreements.

Sea equipment, ground equipment systems, and radar systems are produced under license among the developing nations.

The United States licenses have been granted mainly for aircraft and sea weapon systems. The French military industry has been mainly involved in helicopters and guided missiles. The British and Germans have been particularly active in shipyards.

In the last one-and-one-half decades, licensed production has expanded the Turkish Defense Industry's role in the production of the F-16 aircraft, frigates, submarines, G-3, MG-3 infantry weapons, ammunition, missiles, and artillery.

All of the above data signals the growing phenomenon of the transfer of military technology to the developing countries through the instrument of licenses.

3. Co-production

Co-production may be defined as any program where a government enables an eligible foreign government, international organization, or designated commercial producer to acquire the know-how to manufacture, assemble, repair, maintain and operate,

in whole or in part, a specific weapon, communication or support system, or an individual military item.

The more sophisticated the weapons system is, the higher the share of foreign parts and know-how. Multilateral and bilateral co-production forms are arranged either vertically or horizontally [Ref 38. p. 139].

Vertical co-production means that the industry of the purchasing country not only produces components for the particular weapon system bought by the country, but also produces those components for all the systems, which are constructed abroad. These components can be totally or partially indigenous.

Horizontal co-production in turn contains only the production of components for those weapons acquired by the country. It is self-evident that vertical co-production is more profitable to the producer of the components than horizontal, because in the vertical arrangement, the factors reducing unit costs are more visible. From the standpoint of the seller, the vertical version would be more useful since the cost reduction is beneficial to him. The economic factor may be the main explanation of the fact that vertical co-production projects have been recently on the increase.

There are especially aircraft manufacturers that seem to be most internationalized both in terms of exports, direct investments and co-production patterns. There are more joint projects with

governments and manufacturers from developed rather than developing countries.

4. Joint Ventures

Joint ventures can be defined as the development and manufacturing of military system involving more than one military-industrial firm and a significant level of inter-firm cooperation in the areas of research, design, production, and marketing as well as significant contributions by all partners to develop funds and risk capital [Ref 39. p.3].

An increasing number of new investments have been joint ventures involving ownership between local and foreign partners. There are various factors contributing to the growth of joint ventures as a transfer channel of military technology. Developing countries may pass legislation either prohibiting total foreign ownership or making incentives conditional upon certain degrees of local ownership. On the other hand, technology suppliers have become increasingly aware of the benefits of sharing ownership with local partners. These include land, capital, trained personnel, and familiarity with local markets [Ref 14. p.127].

The two types of joint ventures are equity and contractual [Ref 35. p.18-24].

Legislation of the recipient countries encourages the formation of equity joint ventures on the basis of requirements related to the share of equity in local hands and its effects on the decision-making system of the enterprise.

In general the participation share of the local party in joint ventures is at least 15 percent. In the Turkish joint venture example, the Turkish Aerospace Industry, Inc (TUSAS) holds 15 percent of capitalization as a participation share. The foreign partner, General Dynamics with its major subcontractor General Electric is to aid the capitalization of the plant by the provision of 49 percent of the funds required.

Equity joint ventures normally imply the combined transfer of other resources of the foreign enterprises, such as capital and management, so that they cannot be considered as a specific mechanism exclusively for technology transfer.

However, equity joint ventures have an important incidence on the way and conditions in which technology can be transferred from abroad. The main implications concern [Ref 35. p.19]:

- The strategies of technology suppliers--i.e., international corporations and other firms in comparison with the supply of technology through this mechanism,
- The procedures of technology transfer,
- The capacity of the military-industrial firm to ensure an effective transfer.

The other type of joint venture is contractual. The transfer of technology could be the central basic objective of these contracts or

just an aspect of a more complex arrangement. But the essential characteristic of contractual joint ventures is that there is a complete transfer of the resource and the equity ownership of the foreign supplier of the technology. The foreign suppliers are granted rights for only a specified time. In this sense they appear in principle to be a more contractual way of technology transfer than the equity-based arrangements [Ref 35. p.23].

5. Foreign Design Assistance

Foreign design assistance has become an important type of technology transfer.

The supplier country transfers information that may be classified and thus difficult to obtain for designing an indigenous weapons system.

These alternative channels of military technology transfer are not clearly differentiated and thus often overlap. In this sense there are two main points to be considered in the selection of the channel [Ref 35. p.36]. First, generally the terms and conditions negotiated within each form are more important than the forms as such. Second, the correct choice of the channel depends on the type of weapons project, internal capacity of the recipient military-industrial firm, and a constellation of external factors, ranging from legislation to external finance.

From the efficiency point of view it is generally assumed that joint ventures are better than other transfer channels. The first reason is that the technology supplier, who shares the risks and profits of the project will be directly interested in the success of the enterprise. The second reason is that there is a continuous association in responsibility and division of labor between the partners [Ref 35. p.21].

Throughout the network of licenses, co-production, joint ventures and foreign design assistance agreements, today's military technology receiver becomes a producer.

H. THE RESULTS OF MILITARY TECHNOLOGY TRANSFER

The transfer of military technology to developing countries affects the military and the civilian sectors. Moreover, the transfer has benefits and drawbacks to both supplier and receiving countries.

1. The Effects on the Civilian Sector of the Society

The military technology transfer process begins when the policy makers of a developing country decide on the basis of their available resources, security, and development goals to obtain military technology from abroad. After negotiations with the supplier country are complete and the requirements of the buyer country established, the formal transfer of military technology begins. Before receiving the military technology, the military

derives benefits from this transfer such as increased technical, management, and language training; perhaps higher morale, travel abroad; and a larger budget outlay.

However, as the military technology begins to arrive the picture becomes more complicated. Negative spin-offs affect some parts of the society although this can vary with the amount and type of military technology received. For example, increased military demand may create a drain on already scarce human and natural resources, overload insufficient communications networks, and infrastructure facilities. On the other hand, some civilian sectors may derive many unanticipated benefits from these military activities. The housing, communications, transportation, educational, and health sectors are often the first to be mobilized to meet military requests associated with imported military technology.

Bases must be built to store, operate, and maintain new weapons. Housing, roads, railroads, parts, telephones, electricity, water supplies, schools, and hospitals must be established to serve them. In turn these bases, often located in remote regions of the country, stimulate the growth of satellite cities, which leads to further change.

The industrial sector also becomes involved. A larger, better-educated military creates a larger, more sophisticated domestic market. In addition, more food, uniforms, medicines, supplies, and

technical equipment (ranging from batteries to buses) must be purchased by the military from the civilian economy. In this way, not only profits but also large amounts of technical and management know-how, are transferred into the civilian sector. Thus, local manufacturers gear up their production lines for a bigger market and are encouraged to produce a better product.

As the capabilities of the country increase, feedback from the civilian sector influences arms-procurement policies. Security and development goals change as the country grows. Competing pressure groups vie for foreign-exchange resources, domestic industries, and educational institutions provide more of the needed resources so that foreign military equipment and training becomes less necessary and the circle is complete [Ref 40. p.236].

2. The Effects on the Armed Forces

It is becoming increasingly evident that military technology is a powerful factor in shaping military doctrine. Military technologies and doctrine mutually reinforce each other within a political environment [Ref 38. p.254].

When developing countries transfer military technology at the same time, they acquire specific modes of organization and military doctrine from the developed countries.

This is not necessarily bad; however, it cannot help but confuse military planning and raise questions about operational effectiveness. Possession of a new technology is not equivalent to the possession of a new military capability. This technology must be incorporated into the existing military structure. If it cannot, then the structure must be changed (which could entail considerable disruption) or the technology should be abandoned [Ref 41. p.41-42].

As a result of military technology transfer, mainly the structure of the armed forces of a country should change towards a professional organization in order to use the technological development efficiently.

3. Advantages and Disadvantages of Military Technology Transfer:

Military technology transfer has both benefits and drawbacks for recipient countries as well as supplier countries.

a. For the Recipient Country

Through the technology transfer process, the recipient country acquires the necessary military technology, which has been proven technically without an unacceptably high degree of risk on a fast timetable. Moreover, the recipient country can supplement its own development programs, and acquire spare parts and components

easily. However, there are possible disadvantages in becoming a recipient of military technology [Ref 34. p. 8]:

- The recipient could become locked into a particular technology,
- The recipient may assume the obligation to purchase tied-in products, such as spare parts and associated elements while utilizing technology,
- The recipient can be forced to accept restrictions in its marketing and policies relating to the licensed military technology, such as restrictions on export.

b. For the Supplier Country

There are several benefits to suppliers of military technology [Ref 42. p.31]. These include:

- Maintaining reasonable, friendly relations with recipient nations,
- Retaining a share of the market in recipient countries,
- Decreasing the balance-of-payment deficits,
- Establishing the recipient country as a market for both the supplier's spare parts and maintenance services for the transferred technology and, finally,
- Permitting the supplier to acquire a part-interest in the recipient company in return for supplying the technology, such as in a joint venture.

On the other hand, the recipient country could become a competitor and threaten the lead of the supplier's technology. Therefore, the supplier may choose not to supply its military technology. Moreover, the supplier country has the concern that the technology supplied to unstable regimes may someday fall into the hands of hostile forces. Finally, the growing arms production in the

developing countries will reduce the supplier's control over some of its more ambitious and independent-minded clients.

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V. TURKISH DEFENSE INDUSTRY AND TECHNOLOGICAL BASE

A. REASONS FOR A TURKISH DEFENSE INDUSTRY

Despite the fact that Turkish Armed Forces (TAFs) is the second largest armed forces in NATO, Turkey failed to build up a self-sufficient defense industry that can provide its armed forces with major defense systems. This led the country to heavily rely on its allies in NATO, mostly on U.S.

Reduced military support from the allied countries due to different disputes with Ankara and lessons learned from the embargoes against Turkey, especially the US embargo after country's peace operation in Cyprus in 1974, urged the country to develop its defense industry.

Caught at the intersection of three points of regional instability formed by Balkans, the Caucasus, and the Middle East, Turkey strongly feels the need to maintain its own defense capacity and expand its national defense industry to support the armed forces.

Military sources have indicated that USD 150 billion will be needed for the next 25 years to fund the modernization program of the Turkish Armed Forces, which has a total approximate size of 566,600 personnel, divided between the Army (450,000), the Navy (51,600) and the Air Force (65,000).[Ref 43 p.18] As a percentage

of GNP (approximately 4 percent) and the Consolidated Budget (approximately 15 percent), Turkish defense spending is one of the highest in NATO and, also on a worldwide scale. However, Turkey obtains 79 percent of its defense equipment through imports, with only 21 percent produced by domestic industries. The level of domestic production is very low considering the size of the armed forces and the level of defense expenditures. Majority of the domestic production projects involve the transfer of technology and production of at least partial units in Turkey.

In a quest to reach at a high level of self-sufficiency in supplying its armed forces with state-of-the-art technology, Turkey recently has accelerated efforts to ready itself for the 21st century by setting up effective and productive defense industry projects with maximum local input. Emphasis has shifted from direct procurement to co-production of weapon systems, thereby developing a sustainable defense industrial base.

To gain access to first-rate technology that other countries are reluctant to export without restriction (e.g., electronic warfare equipment, sensors, encryption equipment. etc.), both military and governmental authorities believe it is necessary to build up and maintain capability in the restricted technologies. Such efforts are expected to prevent it from lagging behind in the 21st century's rapidly growing defense sector.

B. EVOLUTION OF TURKISH DEFENSE INDUSTRY

Turkish defense industry activities have a history dating back to the years when the Ottoman Empire was founded. In this era, during the reign of Conqueror Sultan Mehmet, a foundry (Tophane-i Humayun (Imperial Arsenal)) was built to cast cannon, along with the first shipbuilding facility in Istanbul. In spite of the incremental developments in production of weapons, the defense industrial capacity lagged behind developments in Europe during the final periods of the Empire.

The new republic inherited a very weak infrastructure from the Ottomans. Grasping the importance of a domestic defense industry in support of the armed forces, new steps were taken to create a local production capacity. Shortly after the establishment of the new state, the Golcuk shipyard commenced naval shipbuilding.In 1926 Tayyare ve Motor Turk A.S. (Airplane and Engine Turkish Inc.) was established through an agreement between the Turkish government and Junkers. This company produced 112 aircraft of different types over a 15-year period. In 1943, the Turkkusu Aicraft Factory was founded to manufacture airplane and glider fuselages, some of which in later years were sold to the Netherlands. Due to the lack of orders, and some other political and economical reasons, the factory was shut down in late 1940s [Ref 44 pp. 10-38]. Despite the massive

efforts to set up a domestic defense industry in the early years of the Republic, satisfactory progress was not made.

In 1950, the General Directorate of Military Factories was transformed into a public enterprise, Makina ve Kimya Endustrisi Kurumu (MKEK) (General Directorate of Machine and Chemical Industry), which became the country's principal manufacturer of munitions, explosives, small arms and rocket ordnance.

With the exception of MKEK, until 1970s, Turkish Defense Industry (TDI) was predominantly in the maintenance and manufacturing capabilities of the Turkish Armed Forces (TAFs): repair/overhaul centers, ordnance factories, shipyards, supply and maintenance centers.

A new era started in the history of TDI after Turkey's intervention in Cyprus. In consequence of an embargo that came as a repercussion of the Cyprus Peace Operation, Turkey decided to develop its own defense industry, endeavoring to reach a high level of self-sufficiency in supporting its armed forces.

The immediate response to the aftermath of the embargo was the foundation of the military electronics concern or ASELSAN as it is better known today, which was established as the local Mil-Spec communication systems house.

The catalyst for the contemporary Turkish defense industrialization occurred through the enactment of Law No. 3238,

which went into effect in 1985. The law introduced a number of important conditioning factors for the future development of TDI. It decreed the establishment of the Undersecretariat for Defense Industries (SSM), which gave a boost to Turkey's domestic defense industry.

As a result of the increased efforts to establish a self-sufficient domestic defense industry in the last decade and a half, TDI has successfully carried out several production and modernization projects.

C. TURKISH DEFENSE INDUSTRY TODAY

1. General

In recent years, TDI has developed substantially with the contribution of local and foreign private sector companies. Turkey has come to a point where it can produce the most modern arms and defense equipment. However, although it is self-sufficient in certain fields and has a certain export capacity, it couldn't reach the desired level in foreign markets.

Turkey has been gradually implementing a program to improve defense capabilities and force readiness. The defense-related modernization program began in early 1980s involving co-production of F-16 fighter aircraft, and continued with armored infantry fighting vehicles, frigates, submarines and light transport

aircraft. Emphasis has shifted from direct procurement to co-production of weapon systems. Many of the weapon systems produced in Turkey are licensed or co-produced by foreign industries. The largest joint ventures have been the production of F-16 fighter aircraft, Stinger shoulder-launched anti-aircraft missiles and armored combat vehicles. Other examples of joint production include:

- The Turkish company ASELSAN collaborating with PHILIPS (Netherlands), TEXAS INSTRUMENTS (USA) and LITTON (USA), producing components for F-16 fighter and night vision equipment for infantry vehicles;
- The Arifiye Tank Upgrading plant collaborating with ZEISS, RHEINMETALL, MTU and GLS (all in Germany) on M-48 tanks
- Baris assembling M-72 rocket launchers
- ENKA assembling the Black Hawk helicopter in a joint venture with UNITED TECHNOLOGIES
- TEI collaborating with ROLLS ROYCE (U.K.) producing aircraft engines
- Kayseri Wekplaats is engaged in joint ventures with SIAI-AUGUST (Italy) and MBB(Germany) in upgrading M-113s
- MKEK produces anti-aircraft artillery, rocket launchers, machine guns and ammunition, working with OERLIKON CONTRAVES (Switzerland), HECKLER & KOCH (Germany), GENERAL DEFENSE CORPORATION (USA), RHEINMETALL (Germany), EUROMETAAL (Netherlands) and GIAT (France). [Ref 45.p.61]

Major areas of TDI concentration include, but not limited to, the following fields:

- Defense Electronics
- Ammunition, Barrels and Explosives
- Armored Fighting Vehicles and Main Battle Tanks
- Rocket and Missiles
- Conventional Submarine Construction
- Ship Construction
- Military Aircraft and Helicopters [Ref 46]

2. Current Defense Industrial Structure

Almost all of the defense organizations that form the TDI, especially the companies that have been set up after the foundation of SSM in the last fifteen years, have been established for the purpose of operating in selected areas to compensate for the deficiencies in TDI, and with a structure open to further development. As a result of this approach, the facilities have created significant employment opportunities under the dynamics of free competition. Through the business they provide to supporting industries, they have created an important potential for the defense industry that can provide tangible support when necessary.

All facilities that began production have reached a healthy, self-sufficient level on the foreign and domestic markets. By this growth they have begun to lessen the pressure of defense expenditures on the budget by providing the national economy with considerable input in terms of value-creation.

a. Public Institutions

(1) Public Enterprises. The major defense establishment in this category is MKEK, which operates as a holding company with 19 subsidiaries. MKEK owns military factories that produce a wide range of ammunition, small arms, 105 mm tank guns, rockets, mortars, blasting caps, grenades, mines and batteries.

(2) Military Facilities. This category includes maintenance facilities that repair/overhaul major weapon systems (e.g. Arifiye and Kayseri tank modernization facilities; Air Force overhaul, repair and maintenance facility in Eskisehir) and shipyards of TAFs (the two principal shipyards of Golcuk and Taskizak represent substantial shipbuilding and repair facilities. Ship programs include MEKO 200 frigates, Type 209 submarines and fast patrol boat programs that been under way throughout the 1990s).

(3) Foundation Establishments. The Turkish Armed Forces Foundation (TAFF) was established in 1987, by the unification of Army, Navy and Air Force Foundations. These foundations had been established in early 1970s with the purposes of strengthening the TAFs and minimizing the dependence on other nations by establishing a national defense industry.

Financed mainly through the donations by the Turkish people, TAFF currently has ownership interest in 13 establishments and enterprises (such as, Aselsan, Havelsan, İşbir, Aspilsan, Ditaş, Tusaş, Tai, Tei, Roketsan, Çansaş, Netaş, Mercedes-Benz Türk, Sidaş, Testaş and Petlas) that are involved in defense production.

Major companies, which are primarily owned by TAFF are the following:

ASELSAN (Military Electronic Industries, Inc.) was founded at the end of 1975 to produce tactical military radios and defense electronic systems for the Turkish Army. Since its foundation, ASELSAN has expanded its product and customer spectrum, and organized into three main divisions:The Communications (HC) Division, Microwave and System Technologies (MST) Division, and Microelectronics, Guidance and Electro-Optics (MGEO) Division. The main products manufactured by ASELSAN are Data Terminals, VHF/FM Frequency Hopping Military Radios, Surveillance and Fire Adjustment Radars, Muzzle Velocity Radars, Training Simulators, Man-Portable DF and Pedestal Mounted Air Defense Systems. ASELSAN's quality systems comply with NATO Publication AQAP-110, Military Specification MIL-Q-9858, and International Standards ISO-9001. The company has been exporting its high technology products to 23 different countries including USA, Germany and Switzerland. Recently, the company has managed to gain a place on the inventory list of the French-German Helicopter Consortium's Eurocopter. The consortium will use ASELSAN's FLIR wireless system in helicopters, which are produced by them. TAFF holds 83% of ASELSAN's shares.

HAVELSAN (Aviation Electronics Industries, Inc.) was founded in 1982. The main interest areas of Havelsan are avionics, simulations, electronic warfare and information management systems in the defense industry in particular, and other related sectors in general. Moreover, software system integration, modification and test program development studies are being carried out as regards the aforementioned fields. Being the first and the foremost software house in Turkey, the company has extended its capabilities to abroad with the AQAP 150 Industrial Quality Assurance Certificate of NATO. Havelsan also realizes software and system integration projects in the automation and security fields. Havelsan's 98.7 % shares belong to TAFF.

ASPILSAN (Military Battery Production Industries, Inc.) was established in 1981 with the donations of the people of Kayseri city. Originally established to manufacture rechargeable Nickel-Cadmium batteries to be used in various telecommunication equipment owned by TAFs, the company currently manufactures Nickel-Cadmium batteries, battery packs, aircraft/helicopter cells and batteries, and charging devices within the NATO qualification system AQAP 120. TAFF holds 95 % of ASPİLSAN's shares.

ISBIR (Electronics Industries, Inc.) has been in operation since 1977, in order to produce synchronous alternator

and diesel-generating sets. The company has been producing several electrical components in compliance with NATO Manufacturer Code Nr. T 0528, AQAP 120 and ISO 9002 Quality Assurance System certificates.

b. Private Companies

(1) Aviation and Space Industry. TAI

(Turkish Aerospace Industries) is a joint venture company, which was established in 1984, between Turkish Aircraft Industries Inc. (TUSAÞ) (49%) and Lockheed Martin (42%). It has a modern aircraft facility, furnished with high technology machinery and equipment that provide extensive manufacturing capabilities. Quality systems of TAI meet the stringent world standards including NATO AQAP-120, ISO-9001, MIL-Q-9858A and BOEING D1-9000.

With its proven experience in aircraft and aero structures manufacturing business, TAI is a uniquely qualified supplier for Lockheed Martin Tactical Aircraft Systems, Lockheed Martin Systems (LMVS), Boeing, Sikorsky, Northrop Grumman, Airbus, MD Helicopters, CASA, Agusta, Eurocopter, Sonaca, and many more companies domestically and worldwide. As a full member of the Airbus Military Company, TAI is engaged in the development activities of the Future Large Aircraft (transportation) (A400M) with major European aerospace companies and, also aims to get supply contracts for Joint Strike Fighter (JSF) in exchange

for Turkey's (expected) participation in engineering and development phases of the program.

TAI's experience includes co-production of F-16 fighters (exported 46 aircraft to Egypt), CN-235 light transportation planes, SF-260 trainers, Cougar AS-532 helicopters, as well as design and development of unmanned aerial vehicles, target drones and agricultural aircraft. Furthermore, the company is the prime contractor of the Turkish Armed Forces ATAK Helicopter and Turkish Unmanned Aerial Vehicle Production programs.

TAI's core business also includes modernization, modification and systems integration programs and sales support.

TEI (Tusas Engine Industries, Inc.) was set up in 1985 as a joint venture between Türk Uçak Sanayii A.Ş. (TUSAŞ) and General Electric Company. The company focused initially on manufacturing engine components and assembling engines for the F-16 military aircraft. Since 1990, however, it has become involved with the production, assembly, testing and overhaul of a wide variety of engines and engine components for use in commercial as well as military aircraft. Producing about 200 different parts for overseas buyers and carrying out about two-thirds of its total sales in the form of exports, TEI is one of the largest engine producers in Europe, competing directly with companies such as Snecma, Pratt & Whitney, and Rolls Royce.

PETLAS (Tire Industry & Trade Co.) was established in 1976, and until 1997 continued its activities as a state-owned public enterprise. Petlas produces a rich range of tire products for military and commercial vehicles, as well as airplanes.

(2) Rockets and Missile Industry. ROKETSAN (Missile Industries Inc) was established in June 1988 with the participation of several domestic companies to realize missile and rocket programs in Turkey. ROKETSAN is involved in integrating and producing surface-to-air precision-guided munitions, anti-tank weapons, air defense systems and produces launch and flight motors for European Stingers. The company plays an important role in international technology development programs and is the second largest manufacturer in the Stinger co-productions program. Through both the Stinger Program and the new rocket systems it developed through its own capabilities and experience, ROKETSAN has gone a long way to design, develop and manufacture artillery rocket systems at 122 and 107 mms. with remarkably extended ranges for the TAFs. As well as that, ROKETSAN works on air-to-ground munitions, anti-tank missiles, low-level air defense programs. The company is certified with AQAP-110 certificate and also complies with internationally accepted standards such as MIL-STD-810 on environmental tests and DOD 4145.26-M on safety.

BARIS ELEKTRIK was established in 1979 for the production of epoxy resin current and voltage transformers. The firm, which has been involved in defense industry since 1986, produces Stinger launcher tubes and gyro activators, composite parts and systems, electro-mechanical assembly and harnesses. The firm is capable of designing and producing composite parts and assemblies by making use of the materials laboratory, composite production systems (CNC filament winding machines, RTM system, etc.) and laser cutting center. The Firm has the AQAP-110 certificate and Industrial Security Clearance.

KALEKALIP and CAMIS are the other companies, which contribute to the defense industry by producing components for rockets and missiles.

(3) Military Electronics Industry. MIKES

(Microvave Electronics Systems Incl.) is a joint venture company between various Turkish shareholders and Lockheed Martin, which was initially established for the delivery of integrated electronic warfare (EW) systems for the Turkish F-16 Program (Peace Onyx). Today, MİKES has been primarily engaged in the field of EW, including design, manufacturing, testing (laboratory and field) and complete Integrated Logistics Support.

MARKONI KOMINIKASYON (communications) is a joint venture between Marconi and two local contractors, which

was established to support the modernization of TAFs. The company operates not only in the production of frequency-hopping HF/SSB radios but also in the TASMUS (Tactical Area Communication System) and similar projects. MARKONI, which has become its parent company's sole producer of HF/SSB radios, has also made its first exports in an active search for external markets. MARKONI KOMINIKASYON will also assume the depot-level maintenance and repair activities for the radios in TAFs and, in this way, continue creating real added value for the country.

THOMPSON-TEKFEN was established in 1985, to ensure the production in of mobile radars, which are purchased at a price substantially lower than NATO's direct purchase prices. Considering that its long-term objective is to assume the maintenance and repair of the mobile radars procured, it will be possible to better appreciate the contribution that this firm makes to the Turkish economy and industry. The exports of mobile radars that were made to FRANCE in May 1997 are the clearest sign that significant results can be obtained even from investments carried out with modest objectives.

AYESAS (Aydin Software and Electronics, Inc), which was formed in 1990 for the Turkish Mobile Radar Complex (TMRC) contract, is a high technology software and electronics company, with its most distinctive expertise in the field of real time

software engineering and integration. The company has not confined its activities to command, control and communication systems projects for TAFs. It has expanded its area of activity through contracts obtained from NATO. AYESAS also has major business in custom manufacturing involving electronic assembly, metalwork fabrication, communications hardware, radar data integration, real time C3 Systems, data fusion, and command center design and installation. AYESAS designs, manufactures, tests, installs, and markets high technology digital products in accordance with NATO-certified production and design Quality Assurance at competitive costs. The company is licensed to manufacture the electronic equipment and products of a major shareholder, L-3 Communications, benefiting from its research and development department and overall capabilities.

NETAS, one of the Turkey's main technology exporter with a broad customer base in more than 20 countries, manufactures and delivers switching, communications, data networks, transmission and power systems to telephone operating companies and private institutions. While continuing to deliver under a thorough modernization program, the company is an inseparable part of all new platform and sensor programs. Netas also co-leads the TASMUS/TACS project together with Aselsan. The

company won European Quality Prize given by the European Foundation for Quality Management in 1996 and 1997.

TRANSVARO (electro-optical night vision goggles, mine detectors), **STFA-SAVRONIK** (secure communication systems, firing control systems), **ALCATEL TELETAS** (communication systems), **AREMSAN** (frequency converter, uninterrupted power supply, mobile lightning), **INTER ENGINEERING** (night vision goggles and components), **AKSA** (custom generators), **STM** (E/W , C3I Systems Development) are the other major companies in this segment of the TDI.

(4) Military Shipbuilding. As mentioned previously, the Turkish Naval Forces shipyards that have successfully produced frigates, submarines, landing vessels and various other naval vessels, dominate shipbuilding activities.

SEDEF was founded in 1990 in the Tuzla Private Sector Shipyards Zone and has been rendering services at its facilities covering 134.000 square meter area. The firm is capable of building containers, tugboats, freighters and tankers, and manufacturing floating barges, cranes and various steel constructions (Gantry cranes, bridges, towers, sliding fixtures etc.) The firm has the AQAP-4 certificate.

PKM was established in 1974 at Golden Horn. At the time, the company was only specializing in steel hull

constructions. PKM started to build fiberglass hulls in cooperation with the Italian company Plaver in 1978, and the production of aluminum-constructed vessels was initiated in 1991. PKM has built in 1988 coastal protection boats for NCTR. In 1998 the company started to build two Navy Supply Ships for the Turkish Navy.

(5) Military Vehicles and Armored Carriers.

FMC-NUROL (FNSS) was established as a Turkish based joint venture between United Defense of USA and NUROL Group of Turkey to manufacture 1698 Armored Combat Vehicles for Turkish Army. Based on the well-known field-proven M113 Personnel Carriers, FNSS has developed a broad family of Armored Combat Vehicles and currently produces four versions: Advanced Armored Personnel Carrier (AAPC); Armored TOW Vehicle (ATV); Armored Mortar Vehicle and Armored Infantry Fighting Vehicle (AIFV), each version being available with varied weapon stations. Armored Mortar Vehicle and AIFV are the newest vehicles in this class and incorporate the latest warfare technologies to meet the requirements and operational needs of most modern armies. FNSS has placed great importance on developing the local defense industry by providing training and funding to small businesses through which local participation has reached 80% during the course of six years. In addition to producing tracked armored vehicles for the Turkish Armed Forces, FMC-NUROL (FNNS) also sold armored vehicles to

United Arab Emirates, thus leaving world-leading companies in the West behind. This shows the distance that Turkish Defense Industry has accomplished within a short period of time. While continuing to meet the requirements of the TAFs, FNNS is also trying hard to promote its range of military vehicles in line with the needs of defense sectors from the Middle East to the Far East.

OTOKAR carries out production primarily for civilian needs. Already well established in a niche market of multi-purpose minibuses for the civilian user as well as armoring of those for specific purposes, the company went into the licensed production of the Land Rover tactical vehicle in Turkey. In addition to meeting the domestic demand, the firm - with the support of SSM - has succeeded in marketing the wheeled armored vehicles it has developed (Akrep-Scorpio, Cobra) to a wide range of customers from Pakistan to Algeria.

NUROL MACHINERY, which first produced sub-systems for FNSS, has developed a new model of wheeled armored vehicle at NATO standards, by working with a Romanian firm and using the know-how and experience it gained from the turret production project.

MERCEDES - BENZ TURK INC. has been producing commercial and military vehicles, buses and trucks, to the Turkish market with Mercedes-Benz license.

BMC (tactical vehicles, diesel engine and modernization projects (BTR-60 and BTR-80)), **MAN** (military trucks), **ASMAS** (components for tank modernization), **BURCELIK** (artillery components), **HEMA** (components for hydraulic systems), **IBRAHIM ORS** (mechanical parts for military vehicles), **TURSAV** (transmission for armored vehicles), **HISAR CELIK** are other significant participants in this part of local defense industry.

3. Basic Facts

a. *Capital Turnover*

The total value of material produced by major domestic producers in 1999 was approximately $ 2.2 billion, of which 80 to 83 percent was for equipment to TAFs.

b. *Exports*

Seventeen to twenty percent of the material produced was exported. Export growth is expected in the Turkish defense products in response to the following initiatives.

There is an intensive campaign for the promotion of Turkish defense industry products. Turkish defense products are being promoted in two different ways. The first is the promotion of Turkish defense industrial products and production capabilities by the firms themselves. Turkish firms demonstrate their products in foreign countries, and also invite foreign officials to Turkey where

they visit production lines. Similarly, they demonstrate their products in Turkey, participate in national and international fairs, advertise in the media and open representative offices abroad.

Promotions undertaken by SSM and other related institutions are multidimensional. The Undersecretariat supports Turkish firms in acquiring information about foreign markets. It also aids in the promotion of products at home and abroad, and contributes both financially and administratively. Promotion activities of the Undersecretariat also continue via the Turkish representative offices and military attaches abroad.

c. ***Manpower***

The total number of the employees amounts to about 25000. The number of the employees with high-level technical qualifications is approximately 43 percent of the total.

d. ***Market Share***

The domestic industry is normally awarded approximately 21 percent of the Turkish defense contracts. Of the remainder, largest part goes to the US and European firms.

e. ***Competition***

Although the development of the TDI has not reached the desired level as yet, Turkey has been able to export her products to every corner of the earth in the fields of defense electronics, rockets, aviation and armored vehicles. Turkish frequency

radiotelegraphy and radar are way ahead of their giant competitors in the Far East. There is now a vast market for Turkish armored vehicles in North Africa and in the Middle East, which previously had been taken by Turkey's competitors in this field. The sale of 46 F-16 aircraft produced in the Turkish Aircraft Industry (TAI) to Egypt and armored personnel carriers to United Arab Emirates show Turkish firms' competitiveness in their fields.

f. *Capabilities*

The industry has been developing in most areas. Generally the defense sector makes use of state-of-the-art-technology and is a sector often described as the "locomotive power" of the industry. ASELSAN and TAI are two such establishments, which also produce for civilian purposes.

4. International Cooperation

The need for self-dependent defense industry forces Turkey to participate in projects that will be carried out in future to transfer technology and constitute its defense industry base.

Table.V-1 Turkish Defense Industry: Principal Producers*

Producer	Production (USD/$)	Exports (USD/$)	Work Force
TAI	72,558,000	1,000,000	1,996
TEI	50,188,000	44,629,000	524
PETLAS	45,404,000	11,969,000	686
ROKETSAN	40,309,000	12,732,000	193
MKEK	460,000,000	6,466,000	8,744
KALEKALIP	15,000,000	576,834	350
ASELSAN	196,518,000	23,596,000	2,849
HAVELSAN	11,429,000	91,000	562
MIKES	10,225,000	N/A**	199
AYESAS	17,300,000	266,000	203
TRANSVARO	18,000,000	440,000	100
STFASAV.	9,700,000	N/A	65
NETAS	223,781,000	54,867,000	1,233
AKSA	50,220,000	7,837,000	N/A
STM	4,651,160	93,000	189
COSKUNOZ	22,300,000	4,600,000	691
HEMA	45,416,000	N/A	800
PARSAN	18,000,923	10,000,000	454
OTOKAR	117,223,000	3,607,000	502
BMC	129,974,880	16,000	152
MERCEDES-BENZ TURK	490,697,000	163,000,000	2,868
FNSS	81,395,000	21,000,000	378
NUROL	14,507,000	N/A	131
HISAR	20,983,000	12,600,000	254

*: Includes the largest private companies listed by Defense White Book 2000

Source: Turkish Ministry of Defense, Defense White Book 2000

Defense cooperation activities are conducted mostly within the framework of NATO and the Western European Union (WEU Armament Group). In addition, defense industry activities are carried out on a bilateral basis with many friendly countries. To support its armed forces modernization, Turkey has also established a policy of acquiring new equipment through a variety of channels

including the Southern Region Amendment (SRA), the Conventional Armed Forces in Europe Treaty (CFE) and direct commercial sales (DCS).

France has been one of the countries that have supported Turkey's defense equipment modernization effort. There has been a steady growth of bilateral cooperation since the early 1980s. Cooperation has been formalized through a general agreement concluded in 1991 for defense equipment and followed by specific agreements on radar, light armored vehicles, helicopters and missiles. Further joint ventures were created: Thomson- Tekfen for the production of 3D long-range surveillance radar, the French GIAT Industries and Turkish Nurol Company partnership to produce light armored vehicles equipped with 25mm cannon turrets and more recently, an agreement between Eurocopter and Turkish Aerospace Industry to produce 30 transport Cougar helicopters. France has confirmed its willingness to increase cooperation in other defense industry areas, in particular in the field of short-range anti-tank missiles and by encouraging productive exchanges between Turkish and French small manufacturers.

Israel has invested considerably in research and development to establish cooperation with Turkish industries on a large-scale of activities. Recent projects have included: F-5 upgrade, Russian-Israeli team (Kamov Company and Israel Aircraft Industries—

IAI/Lahav) for a 145 combat helicopter bid, Israel Military Industries Ltd. (IMI) retrofit and upgrade program of the Turkish M60 MBT offer, the NEGEV machine-gun, Python-4 (short-range air-to-air missile), Elop's electro-optical surveillance and reconnaissance systems and UAV aircraft. In addition, Soltam Ltd. has been active in the sector.

Some of the other third country suppliers that have been active in Turkey are: Lurssen Werft, Sel Defense Systems, CAE Elektronik GmbH, Diehl Ammunition, Voith Hydro, Aeromaritime Systembau GmbH (Germany), Eurometaal (Netherlands), CASA (Construcciones Aeronauticas, S.A.) (Spain), Marconi Electronic Systems, Underwater Weapons Division (U.K.) and Avia Baltika Aviation, Ltd. (Lithuania).

D. MILITARY MODERNIZATION PROGRAMME AND THE CURRENT DEFENSE PROJECTS

The roots of Turkey's modernization program go back to the reorganization of the defense industry ordered by Act No. 3238 in November 1985. The act was designed to help Turkey respond better to the rapid technological changes in the defense industry and provide its armed forces with modern defense equipment. The objective of the was "to bring her domestic industry to a level which will produce economically feasible military products necessary for the modernization of TAFs, with the ability to follow

and easily adapt to the latest technological changes. This will provide deterrence." [Ref. 47 p.18] The act did provide a systematic process for linking Turkish national strategy to defense acquisition and put in place a threat-driven defense programming process, which called for a fundamental reassessment of the underlying justification for acquiring military equipment only once every decade.

During a briefing in 1996, the General Staff announced that US$ 150 billion would be needed to fund arms procurement and operations of TAFs for the next 25 years. The bulk of the funds will be allocated to the Army. The main staples of the procurement plan are the purchase of 145 attack helicopters and 1000 main battle tanks. During that period the Navy will require $25 billion, and the Air Force $65 billion in arms and equipment. [Ref. 48 p.3] Accordingly, Turkey had planned to spend $31 billion between 1996 and 2007 on the modernization of the Turkish Armed Forces under the Ten-Year Acquisition Program (OYTEP) concept.

The main programs covered in the modernization program focused on the development of advanced weapon platforms, missiles, and aerospace capabilities required by the NATO air-land battle doctrine.

During the next 25 to 30 years, a significant percentage of the combat weapons and equipment existing in the TAFs' inventory will

be modernized or replaced with systems that incorporate new technology. Some of the modernization projects currently conducted and/or planned by the Turkish Armed Forces are:

- **Joint Projects:** TAFs Integrated Communication System (TAFICS); TAFs Command & Control Information System; Tactical Area Communication System; Frequency-Hopping Secure Radio; Unmanned Aircraft; Local Manufacturing Of Rocket And Missile Systems; Satellite Surveillance System
- **Major Projects Of The Army:** Various Radar Systems; Electronic Warfare Ranging, Listening And Jamming Systems; Various Radio, Encryption And Computer Systems; Modern Anti-Tank Weapons; Low-Altitude Air Defense Systems; Armored Personnel Carriers; Self-Propelled Howitzer Modernization; Third-Generation Main Battle Tank; All Types Of Helicopters With Priority For Assault/Attack
- **Major Projects Of The Navy:** Long Horizon (Uzun Ufuk) Project (Observation/Reconnaissance); Maritime Patrol And Surveillance Aircraft; Turkish Frigate Program; Procurement And Modernization Of Surveillance Radars; Procurement Of New Type Of Mine Hunting And Mine Countermeasures Vessels, Procurement Of New Type Of Patrol Vessels, Procurement, Modernization And Production Of Various Terminals
- **Major Projects Of The Air Force:** F-16 Project; F-5 Modernization; Aircraft And Helicopter Electronic Warfare Systems; Modern Air-To-Air And Air-To-Ground Rockets; Air Defense Missile Systems; Reconnaissance System With The Capability Of Real-Time Data Transmission And Evaluation; Command And Control And Intelligence Satellite Systems; Tanker Aircraft; Future Combat Aircraft Project; Airborne Warning And Control System (AWACS) Aircraft
- **Projects Conducted Within NATO:** Research And Technologies Projects; NATO Identification System; Battlefield Intelligence Collection And Evaluation System (BICES); Global Positioning System (NAVSTAR/GPS); Allied Ground Surveillance (AGS) System; Extended Air Defense; Continuous Acquisition And Life Cycle Cost (CALS); Short-And Very Short-Range Air Defense Systems (SHORADS/VSHRADS);

Post-2000 Tactical Combat Systems (TAC-OMS POST-2000)

E. CURRENT TECHNOLOGIES IN DEFENSE INDUSTRY

Until 1980s, Turkish defense industry base and especially its technological capacity were very restricted to the production of conventional weapons such as light guns and their ammunition. After 1985, with the advance of ASELSAN in production of military electronics systems and the establishment of TAI for the production of F-16s helped Turkish Defense Industry shape itself with the needs of military. However, because of the small size of the defense industry, the change has not been on a large scale.

In 1985, Undersecretariat for Defense Industry has been established. This change in the bureaucracy increased the private sector participation in defense industry. Private sector began to take part in the defense-related activities and has helped shape the continuous improvements in the defense industry. With respect to projects carried out from 1985, almost all the goals of the projects have been reached except the ones that needed restricted technology transfer or the ones that lacked the sufficient resources.

There have been large amounts of resource allocation to the research and development activities between 1985 and 1997. The amount of the resources is 2000 times the amount allocated between

1923 and 1985. After 1985, universities, research institutes and defense industry firms began to share.

The technologies developed or worked on up to now cannot fully satisfy the needs of the Turkish Armed Forces. Moreover, they cannot make the defense industry independent from foreign sources. The main reason for this is the limited financial resources of the government. There are some imminent operational and support needs that should be met in a short period; the resources, which should be allocated to new weapons development activities that will help gain the military critical technology, may be used for those current needs. Moreover, the resources allocated to the activities could be instead provided from private sector. This misuse of resources undermines the achievements needed in military technology transfer.

Despite its limited resources, Undersecretariat of the Defense Ministry has been working on a project that would shape the 21st century of the Turkish Defense Industry with its technological goals.

Today the Turkish Defense Industry, if allocated enough funds, should be capable of meeting a significant part of the requirements of the Turkish Armed Forces. Both systems produced for the TAFs and the success of Turkish companies on the international market reveal that Turkish defense technology is advanced and can compete in international markets.

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VI. AN ASSESMENT OF THE TURKISH DEFENSE INDUSTRY

A. FACTORS THAT OBSTRUCTED THE DEVELOPMENT OF THE TURKISH DEFENSE INDUSTRY

1. The Lack of Defense Strategies and Policies

Until recently there has not been a document that would support the development of the domestic defense industrial base and direct the country's defense industry policies. The lack of such a document has caused inconsistency in the approaches of the government and the private sector toward the national defense industry and resulted in:

- No established healthy defense structure,
- No defense system grouping,
- No defense contractor grouping,
- Lack of the implementation of offsets.

2. Deficiencies in R&D Directed Acquisitions

Most of the weapon systems and defense equipment that were provided by the domestic companies have not been the product of a healthy R&D activity. Foreign contractors generally have made all the research and development for the products and local firms have only put together the production part of the domestically-produced military equipment. This approach has caused the dependency of the

national companies to the foreign firms for the critical part of the systems design and development.

3. Deficiencies in Science and Technology Infrastructure

The Turkish science and technology base has not been developed satisfactorily to meet the needs of the Turkish Armed Forces. Due to the lack of R&D activities, the country has been suffering from the lack of scientists and engineers as well as laboratories and R&D centers for the production of military equipment.

However, the important point is to transfer scientific knowledge into product development and produce technology. It is important to have the ability to produce technology-development capabilities. This is especially true in the transfer of production technology in the case of Turkey. If the trend goes on to transfer only production technologies, there will not be a technological infrastructure that supports national defense industrial base.

4. Lack of Long Term Planning

The companies working in the defense industry should be informed in advance of the long-term requirements of the armed forces. Otherwise, when the military wishes to buy a weapons system, it must wait for industry to put infrastructure in place to

support development and actual production of the weapons system. This situation delays the availability of the weapon systems that the military requires . Until the 1990s, there was no long-term military acquisition planning in Turkey and the armed forces only contracted on a short-term basis.

In recent years, however, the defense requirements have been planned on a future-ten-year basis and feasibility studies are now conducted with the arms-producing contractors.

5. The Lack of Qualified Human Resources

The number and the capacity of the universities in Turkey is not sufficient to provide the nation with the desired quantity and quality of technical personnel. Moreover, as a result of this lack of research and development activities and the tendency to deal with only production not with R&D causes the qualified people to leave for other countries to further develop themselves and take part in research.

6. Search for the Perfect Competition in the Defense Industry

Competition is needed for the effective use of the already constrained resources. It encourages both the firms to be able to introduce new technologies and nations to strive for the most-advanced technologies.

Competition may be both national and international. For a country like Turkey, international competition may not be the best case, because in Turkey, there is a lack of technologically advanced military contractors. In each case of weapon acquisition, foreign or international firms may have the advantage over the national ones. The result may then be the loss of existing national companies.

Encouraging the national firms to cooperate with each other can be an effective way of reaching a more independent defense industrial base. Then, we may conclude that a totally independent industrial base is not a practical way of achieving national freedom of action.

B. UNDER-SECRETARIAT FOR THE DEFENSE INDUSTRY

To overcome the obstacles which hindered the development of the local defense industry, The Under-secretariat for the Defense Industry (SSM) was set up by a special law in 1985. In this way, a single institution, which has the adequate financial and administrative capabilities, would undertake the ambitious task of coordinating efforts for modernization of the TAFs and for setting up the infrastructure of a modern defense industry. Another important goal to be pursued by this institution is to direct the process of industrialization and to set up an infrastructure which

will benefit from the dynamism of the Turkish and foreign private sectors, consistent with national will.

SSM is a subordinate organization of MoND having a corporate body with a special budget. It has been set up as a part of a five-part national defense industry organization. Its main functions are:

- to execute the decisions made by the Defense Industry Executive Committee, which is formed by the Chief of General Staff, Minister of Defense and Prime Minister,
- to reorganize and integrate the defense industry with national industry in accordance with the needs of the defense industry,
- to encourage the new private, public and mixed investments with other economical and financial measures, if necessary,
- to prepare production programs relating to the projects for ensuring procurement,
- to monitor that the contract items are fulfilled,
- to ensure quality controls,
- to research and develop modern combat weapons and equipment, including the production of prototypes,
- to coordinate the export of the defense industry products and the offset trade issues. [Ref 49 p.25].

As a result of the activities of SSM during the 15-year period since the promulgation of the law, a relatively short period of time from the aspect of defense industry, noteworthy achievements have been made. Defense equipment produced domestically and the level of domestically produced weapons, vehicles and other military equipment in TAFs' inventory has increased substantially and the public interest in the sector has gradually increased.

Despite the fact that Undersecretariat was established for the sake of improving the infrastructure of the defense industry in Turkey, it takes into account the needs of the public sector for carrying out the projects. The possible needs of other state institutions are being taken into account as well as the commercial requirements.

C. THE ROLE AND MISSION OF THE TURKISH DEFENSE INDUSTRY IN SUPPORTING TURKISH ARMED FORCES

There are various laws that constitute the defense industry policies. In those laws, the role and mission of the defense industry in supporting the Turkish Armed Forces has been defined. Moreover, the policies and strategies that the Ministry of National Defense should follow concerning the future of the armed forces and its needs have been written in the laws.

The main mission of the defense industry is to continuously evaluate itself and develop the weapon systems that the armed forces need. The companies should keep in contact with the armed forces to find out their requirements and continue their work in close coordination with them. They should not only produce weapon systems but work on research and development activities as well.

To achieve the mission, the services should plan the future and design their needs in coordination with companies in the

defense industry and implement the results. The armed forces should carefully plan its strategies for the future and then design its needs with respect to its strategies. The military should give priority to national companies.

The main government agency for acquiring weapon systems is the Ministry of National Defense. With respect to its role in acquisition process, it should always keep in contact with the military and determine the armed forces' needs. To help develop the national defense industry, the defense ministry should give priority and incentives to indigenous firms.

All the three components of the weapons acquisition --that is MoND, the services, and defense contractors-- process need to work and plan together.

D. DEFENSE EXPENDITURES AND FINANCIAL RESOURCES

Among its NATO allies, Turkey has consistently been one of the biggest spenders on weapon systems and military equipment. Since the end of the Cold War most of the Western European countries have cut defense spending to levels sufficient for little more than maintenance of the existing forces. Western European NATO members spend on the average 60 percent of their defense budget on personnel and only 16 percent on new equipment. By

NATO estimates, Turkey spends nearly twice the NATO average -- around 30 percent -- of its defense budget on new weapons.

The sources of funds to meet the Turkish military expenditures include the Ministry of National Defense budget; income from the Turkish Armed Forces Foundation; the Turkish Defense Industry Fund; income derived from the sale of surplus equipment, services, or other goods earmarked for the Ministry of National Defense; as well as funds allocated by the Under secretariat of Treasury for loan payments, plus the General Command of Gendarmerie budget and the Coast Guard Command budget.

Table VI-1 provides a picture of the funding sources of Turkey's defense expenditures for the 10-year period between 1988-1997. The table shows that Turkey spent a total of US$ 27.8 billion during this period. The list also shows that Turkey met its defense spending needs through the Defense Industry Support Fund, foreign-based state and company credits, foreign military sales credits, as well as the Defense Ministry's yearly budgets.

Turkey's defense expenditures during the period from January 1 to December 31,1999 amounted to US$ 6.3 billion which was a 1.8 percent increase in real terms from 1998 [Ref 44. p.18]. However, these figures represent funding for the Ministry of National Defense only and with the adjustment to reflect the contributions from the Turkish Armed Forces Foundation and other sources, it reached to

US$ 9.6 billion. An early figure of $5.4 billion for defense expenditure in 2000, was pronounced by the Turkish Military attaché to Washington. "Of that amount, $1 billion went to modernization efforts, such as upgrades in avionics and other electronic warfare systems for Turkey's fighter aircraft," he said.

Table VI-1. Sources of Turkish Military Expenditure

THE DETAILED PICTURE OF FUNDING SOURCES FOR THE TURKISH ARMED FORCES DEFENCE NEEDS (INCLUDING AMMUNITION) (1988-1997) MILLION $

Year	Defence Ministry Budget	Defence Industry Support Fund	US Security Aid	German Aid	Foreign State, Firm Credits	NATO Inf. Fund	Turkish Defence Fund	Special Allo-cations	TAF Foun-dation	Total
1988	610,4	2,0	490,0	25,5	114,0	326,9	-	69,2	18,0	1656,0
1989	665,4	105,0	500,0	25,5	113,9	290,0	-	199,4	14,7	1913,9
1990	905,9	424,0	497,0	25,5	114,0	341,9	-	69,3	14,6	2392,2
1991	934,6	468,0	582,0	25,5	113,9	318,7	550,0	154,1	12,1	3158,9
1992	878,3	530,0	500,0	25,5	114,0	494,7	525,0	70,4	11,1	3149,0
1993	1394,3	600,0	450,0	25,5	113,9	329,5	475,0	119,3	6,4	3513,9
1994	859,9	495,0	405,0	-	114,0	155,0	475,0	91,0	4,6	2599,5
1995	820,2	714,0	328,5	-	186,0	207,0	475,0	70,9	9,4	2811,0
1996	1296,0	883,6	320,0	-	498,4	116,0	150,0	79,4	15,7	3359,1
1997 (Estimate)	1482,7	871,6	175,0	-	120,0	148,1	350,0	102,0	9,0	3258,4
TOTAL	**9847,7**	**5093,2**	**4247,5**	**153,0**	**1602,1**	**2727,8**	**3000,0**	**1025,0**	**115,6**	**27811,9**
Share (%)	35,4	18,3	15,3	0,6	5,8	9,8	10,7	3,7	0,4	99,9

Source: Aris, Hakki, NATO'S Sixteen Nations & Partners for Peace, Uithoorn,1998, p.68-72

Due to its security needs and burden-sharing responsibilities against NATO, Turkey is not likely to achieve significant reductions in its defense expenditures over the next 5 to 10 years, although there is planning to reduce the size of the armed forces significantly over the next five years. In fact, Turkey has been encouraged to modernize its forces and promote inter-operability of equipment through the purchase of US and other NATO countries' defense goods.

Foreign Military Sales credits were used to finance the early co-production programs, however, commercial joint ventures are now providing the necessary capital.

E. ECONOMIC EFFECTS OF THE TURKISH DEFENSE INDUSTRY

Compared with the rest of the world, Turkey's expenditures on military systems depend mostly on imports. This dependence causes the opportunity costs of acquiring highly complex systems to be very high.

After the late 1980s, most countries' defense expenditures declined, however, Turkey's increased. What geo-political and geo-strategic issues caused this increase is not relevant to the scope of this study. However, the terrorist activities in the southeastern part of the country and tensions with its neighbors affected this dramatic increase in spending on military systems. Moreover, the modernization efforts caused and required large spending. With respect to the activities mentioned above, having a national defense industry base can at least remove the dependency to the foreigners and reduce the opportunity costs of acquiring weapon systems.

Compared with other sectors, defense companies have relatively larger value-added than service and agriculture companies. Having a larger value-added shows the efficiency of the defense sector companies.

This reality implies one more significance of having a national defense industrial base.

The defense industry has positive effects on employment and subordinate sectors. Increasing participation of companies in the defense sector causes the unemployment rate to be low with respect to the size of the industry and helps the establishment of new companies producing the needed parts and components by larger firms.

The new age is about technology and information. There should be more expenditure on research and development than ever to compete with the rest of the world. Companies working in the defense industry share most of the spending in research and development compared with the overall industry. This situation helps Turkey to develop new systems in every aspect of industrial life capable of maintaining itself without help of foreign assistance for the future.

Producing its own technological base and defense industry helps to sustain macroeconomic balances by reducing imports and increasing exports. First, acquiring weapon systems from inside of the country reduces the expenditures on imports. Moreover, sale of those systems for other countries increases the GDP and improves the balance of payments to foreign countries.

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VII. FUTURE DEFENSE REQUIREMENTS OF TURKEY

A. TURKEY'S STRATEGIC POSITION

Turkey's strategic importance stems from the country's unique geopolitical position, where Turkey is at the junction of Europe, Russia, Central Asia, the Gulf States, and the Middle East.

Turkey remains the southern anchor of NATO, positioned in the heart of one of the most volatile and vital regions for international political and economic security. The country likewise remains the hub where Europe, Russia, Central Asia, Gulf States, and Middle East come together.

Taking its geographical location, Turkey is at the center of a potential crisis triangle as well in a position offering golden opportunities. With its geographical structure, including 8210 km of coastline and Turkish straits, Turkey holds a very important position for both the Black Sea countries and international sea transportation: this location, controlling the eastern Mediterranean and the Suez Canal, Turkey maintains a window to the west for the Middle East, Iran, the Caucasus and Central Asia. With these features, it is a unique country in the region.

Turkey is located in a very close geographical proximity to the Balkans. In addition, it has historical, cultural and economic ties with all the region's countries. It is self-evident that Turkey has a

key role to play in ensuring the stability and security of the Balkans and of the entire Euro-Atlantic area.

Moreover, Turkey has the same cultural, historical and social ties indicated in relation to the Balkans with people living in Caucasus area. A friendly and Western-oriented Turkey represents the best avenue for the transport of oil from the Caspian Sea. Indeed, Turkey could become the gatekeeper of the huge reserves of the Caspian Basin. A pipeline through Turkey would represent an alternative or a complement to either a Russian or an Iranian/Iraqi route. This would help guarantee unimpeded access to a vital energy source. Revenues from Caspian Sea oil also could provide desperately needed capital and revenue to some of the nations of this region and contribute to their domestic stability. In doing so, it would assist these nations emerging from communism and nurture healthy relations with the western countries.

In many ways, water is as precious a resource as oil in this part of the world. The Tigris and Euphrates Rivers originate in Turkey. Their water flows are critical for the agricultural needs of the Gulf and Eastern Mediterranean countries. This makes Turkey a gatekeeper for water too. How it exercises this power can be of immense importance to western countries' interests.

Turkey has the potential to become a key regional leader. Turkey has made clear an interest in developing the natural cultural,

religious, political and economic ties with the Turkish language states of Central Asia, Kazakhstan, Kyrgystan, Uzbekistan, Turkmenistan, Tadgikistan, and Azerbaijan.

Turkey finds itself caught at the intersection of three points of regional instability formed by the Balkans, the Caucasus, and the Middle East. Whereas Turkish strategists once saw themselves living in a bad neighborhood surrounded by a ring of fire with only NATO to guarantee to deter Soviet adventurism, they now find Turkey encircled by the ashes of failed or failing states. From being on the strategic defensive since the 1940s, decision-makers in Ankara should now grapple with more assertive security policies. They should seek to take advantage of new opportunities and preserve Turkish interests in the face of an uncertain future.

At the same time, Turkey is confident in the dynamic structure of its people. The strategy can be summarized as follows: on the one hand, it will preserve its humanitarian and moral values; and on the other, it will work on the technological infrastructure of the information age. Its main targets are to complete the economic and technological development of the Turkish nation and attain the same level as the western countries, and to play a decisive role in the strengthening of the peace and stability environment of its region in cooperation with the international community.

B. TURKEY'S NATIONAL SECURITY POLICY

1. General

The developments in the geography of the Balkans, Caucasia, and the Middle East (the most sensitive regions of the world after the Cold War), have brought new dimensions to the activities and roles of Turkey. The developments in those regions will play a determining role in the future of Europe and the world. Turkey is trying to fulfill its responsibilities and to benefit from new opportunities. It is obliged to continue its effectiveness and determining role in such an important geography. It is not possible to integrate Europe and Asia as long as peace and stability are not provided in those regions. Turkey's contributions to initiatives to stop the conflicts in those regions are directed to the realization of this integration.

Turkey is a center of attraction and can become a driving force of change for peace, stability, and prosperity in the troubled geography mentioned above. With its abundant resources, demographic structure, democratic and secular regime based on the supremacy of law, Turkey is an exemplary country in the region. Its importance is gradually increasing due to its geo-political and geo-strategic location in the changing world conjuncture.

Turkey believes that an environment of peace and security in a region confronted with various problems could be possible by the

activation of political and economic cooperation potentials. For this reason, it directs its efforts towards contributing to peace and security in the regional and global plan. It plays a leading role for the best utilization of the historical and political opportunities emerging after the Cold War [Ref 50. p.7].

2. Turkey's Strategy

Turkey is a country that is powerful in its region and in the world. It directs its efforts towards taking under control the existing and potential disputes in her surroundings. The basic philosophy of the role Turkey plays is the development of economic relations, establishment of political stability and providing for the integration of the countries in its region and in the world [Ref 50. p.10]. Within this context, Turkey reflects democracy, tolerance and the attributes of a legal state to its surroundings.

Turkey's vision in the 21st century is to bring the regional resources to Europe and to the rest of the world. It wants to advance globalization, and emerge as a country having a principal role in this movement. Moreover, it wants to be a leading country and side by peace and development and cooperation efforts for progress [Ref 50. p. 22].

Turkey opens itself and reaches out to the present world where geographical distances are not important. It seeks friends, markets

and new relations within a broad spectrum extending from the Far East to Latin America. It wants to advance on the course of becoming a global state.

As a result, Turkey prepares itself for the role it will assume in the 21st century. It is aware of its responsibilities and will continue more effectively its function of being a bridge between the east and the west.

3. Security Objectives

During the process of worldwide rapid change in late 1980s, a new international system emerged and Soviet Union and Eastern Bloc collapsed. Within the new international system, Turkey is situated at the center of the Eurasian region that has become the focal point of the globe. During this process, Europe has ceased to be divided and the central and Eastern European countries have integrated with their western counterparts.

Turkey is situated at an important geographical location, where Europe and Asia meet. Its geographical location enables Turkey to include all the characteristics of Europe, Middle East, Balkans, Caucasian, Mediterranean, and the Black Sea regions. Its location at the crossroads of an East-West and North-South axis enhances Turkey's geopolitical importance since it is a natural route

for the transfer of the rich energy resources from the Middle East and Eurasian regions to Europe and world markets.

Turkey's historical background and its delicate geo-strategic position require a global approach to national, regional, and international developments. For a country like Turkey to ensure its optimum state of development within a safe environment, the determination of Turkey's medium and long-term security objectives is a scientific problem. In this respect, strategy and national security are bound together. Turkey must determine its strategies and security objectives in a very broad context. Thus, Turkey should solve the issue of determining medium and long-term strategies and security objectives, not only according to the conditions in the country, but also according to the global conditions.

One security objective may be Turkey's enhanced effectiveness within the existing system of interaction in its own region and in the international arena. To reach this objective, Turkey should follow the economic and international relations developments. It should follow the developments of culture, arts, science and technology, and developments in all fields. As a result of this pursuit, Turkey should adapt its economic and social capital and human resources to the process of rapid change in the global arena.

In a system established under this objective of global interaction in an active way, there may be some conditions for determining the area of movement. There would be problems for Turkey to solve while pursuing its security objectives and Turkey should solve them on the basis of technological knowledge. This kind of solution requires scientific and technological infrastructure with minimum cost and maximum efficiency and effectiveness.

4. Strategic Alternatives

Turkey's foreign and security policy undergoes revision and redefinition according to the changes in Turkey's security environment. Aware of the conjuncture in the world politics and Turkey's geo-strategic importance, there are five options that Turkey may pursue in the world arena of politics and military [Ref 51. p. 48]: the European option, Eurasian option, Middle Eastern option, a strategic partnership with the USA, and multi-dimensional policy options.

In the first option, Turkey may strengthen its ties to Europe. European Union membership has been a top priority for Turkey since 1960s and Turkey may accelerate efforts to achieve it.

In the Eurasian option, Turkey may concentrate on strengthening ties to the Turkish states in the Central Asia and in

Caucasus. While not breaking ties with the West, Turkey may define itself more as a Eurasian power.

In the third option, Turkey may emphasize its Islamic heritage and seek ways to strengthen ties to the Islamic countries of the Middle East and Asia. However, this option is the least likely one to be followed.

Strategic partnership with the USA may be the centerpiece in Turkey's strategy for the beginning of the 21st century as a fourth option. However, it is known that, despite the state of alliance between the two states, both countries have different point of views on certain points in the world politics.

In the multi-dimensional policy option, Turkey may pursue a strategy based more on national interests. It may still seek good relations with Europe and follow European membership, however it should not be an obsession. In the option with USA, it may maintain strong ties with USA; however, at the same time it should seek a broad-based partnership.

Regardless of which option is chosen, Turkey should pursue a more active policy in the future. Such a policy would be in keeping up with the changes with the security environment of Turkey.

5. Nature of Future Military Threats

In the last decades of the 20th century, high technology has been the defining character of the warfare in industrialized countries. However, high technology has not been always the central ingredient of TAFs. After 1980s, TAFs began to realize the importance of technologically advanced weapon systems. Then, it began to emphasize the projects giving importance to the requirements of the new kind of warfare that may be seen in 21st century.

There are five kinds of military threats that may be seen in the 21st century: long-range precision strikes, information warfare, dominating maneuver, space warfare [Ref 52. p. 38], weapons of mass destruction including nuclear warfare, and asymmetric threats.

a. Precision Strike

Precision strike is the ability to sense the enemy at operational and strategic depth. It is the ability to recognize enemy's operational concept and strategic plan, and select and prioritize attacks on enemy targets of value. Precision strike is intended to achieve decisive impact on the outcome of the campaign. To be most effective, precision strike attacks should be synchronized in time and space.

The revolutionary potential of precision strike derives from the technologies that provided a glimpse of their own

potential. Technologies related to precision strike concept enable commanders to have continuous wide-area surveillance and target acquisition, near-real-time responsiveness, and highly accurate, long-range weapons at their disposal.

Advances in technology are currently driving this area of warfare. The key improvements now are occurring in broadening the environmental conditions for wide area surveillance and precision targeting; security and counter-measures; data processing and communications; delivery platforms; precision munitions; and positioning/locating devices [Ref 52. p.74].

b. Information Warfare

The second military threat comes from the revolution in information systems. It is this warfare threat that is associated with information systems, their associated capabilities, and their effects on military organizations and operations. This new area of warfare is called information warfare. It is defined as the struggle between two or more opponents for control of the battlefield information.

At the national level, information warfare could be viewed as a new form of strategic warfare. One of the key issues is the vulnerability of socio-economic systems. In this context, the important question to be answered is the issue of attacking the enemy's system while protecting one's own. At the military operational level, information warfare may contribute to major

changes in the conduct of warfare. Therefore, one of the key issues is the vulnerability of command, control, communications, and intelligence systems. The problem goes beyond the armed forces to the entire national security infrastructure. As the international information infrastructure grows and elaborates, its reach is beyond the control of any single entity or any single nation.

c. Dominating Maneuver

One of the more recently identified potential warfare areas is dominating maneuver. Maneuver has always been an essential element in warfare, and the ability to conduct maneuver on a global scale, on a much-compressed time scale, and with greatly reduced forces will always be an important element in the battlefields in the 21st century.

Dominating maneuver is the positioning of forces, integrated with precision strikes, space warfare, and information war operations, to attack decisive points, defeat the enemy center of gravity, and accomplish campaign or war objectives [Ref 52. p.81].

While precision strike and information warfare destroys enemy assets and disrupts its situational awareness, dominating maneuver strikes at the enemy center of gravity. Its aim is to put the enemy in an untenable position, leaving him with no choice but to accept defeat or accede to the demands placed on him.

d. Space Warfare

Space warfare is defined as the exploitation of the space environment to conduct full-spectrum, near-real-time, global military operations. It includes facets of the other three warfare areas but has the potential to become a qualitatively distinct warfare area in its own right [Ref 52. p.88].

If properly placed and employed, space assets may perform missions in much less time than state-of-the-art aircraft, one possible mission is to use space forces to directly achieve national objectives (operational or strategic) in a particular theater. Space strike systems based on satellites or on atmospheric vehicles enable precision strikes, whose quantitative advantage in speed would result in a qualitative difference in capability.

The altitude advantages provided by space greatly improve surveillance and reconnaissance coverage of the earth. As a result, space assets may offer the means to command and control operations in theaters where distance and terrain complicate or confound terrestrially based systems.

However, space has limiting factors that could constrain its military use. First, space is not amenable to human life. It limits the manned presence in future space operations. As a result, most of the improvements in future space operations will most likely come through unmanned technologies. In addition, the speeds associated

with space flight and the amounts of fuel required to maneuver in orbit using current technologies and energy sources greatly limit the flexibility of spacecraft in orbit.

e. Nuclear Threat

The nuclear threat should be taken into account as a fifth alternative threat in the 21st century. Most military planners have judged that the most plausible route to nuclear war is the escalation from conventional war [Ref 53. p.22]. However, even if there is a situation where the risk of conventional war has declined, there is always a possibility that nuclear war may exist, given that all the surrounding countries of Turkey want to achieve nuclear capability and other types of weapons of mass destruction. In short, this point should be understood that nuclear war might be so horrible that no one can easily imagine a provocation strong enough to start one.

Discussion of asymmetric threats is addressed later in the thesis.

6. Possible Future Force Structure

Turkey is located in the middle of the unstable triangle (the Balkans, Caucasus, and the Middle East) in the world. For this reason, it is unable to relax the way many countries can. It is faced with complex and variable security problems.

The existing conflicts and instabilities around Turkey directly affect its political, economic, and social balance. It is vitally important not only for its security but also for regional, European, and global peace that Turkey should be able to maintain its position as an island of stability.

For this reason, in spite of all its economic difficulties, Turkey must have a national defense industry and strong and effective armed forces. TAFs must be able to remove any threats and/or risks, which could originate from adjacent countries and from the environment of internal threat supported by external powers.

Despite all the adverse developments around Turkey, the traditional defense policy pursued by Turkey is and should be based on the principles of peace at home, peace abroad, protecting and maintaining the independence and territorial integrity of the republic.

In addition, taking part in cooperative defensive weapon systems and contributing to regional and global peace by participating in international forces are and should be the principles of Turkey's defense policy. The clearest expression of this approach is the exemplary practices of the TAFs in the Republics of Central Asia, the Caucasus and the Balkans under the Partnership for Peace.

For the reasons mentioned above, the structure of TAFs that should carry out the defense policies of the 21st century should have the following:

TAF should possess modern weapon systems, based on its use in joint operations. It should have modern target acquisition, identification, warning and command and control instruments.

It should respond to the present and future defense requirements and can be maintained economically in peacetime.

It should be capable of providing deterrence, going rapidly from a peacetime-mode into a war-mode, rapidly shifting forces from one area to the other and concentrating on another and supported by high firepower.

7. Characteristics of Future Turkish Armed Forces

In order to overcome against external and internal threats that target Turkey's territorial integrity and the republic regime, such as regional and ethnic conflicts, and the spread of weapons of mass destruction, religious fanaticism, drug trafficking, and international terrorism, TAFs must become a force having the capabilities not only of deterrence and strategic defense, but also of the rapid deployment to the distant places of vital importance in view of the new threats and the risks. Therefore in addition to deterrence and collective security, Turkey should develop operational capabilities

for "forward engagement" and "forward defense" and be prepared to preempt threats to Turkish interests before they cross into Turkish territory.

In light of these TAF should have several characteristics. First, it should be increasingly agile. Not only it should be able to move very quickly over great distances, but also equally capable of rapid operations at the tactical level once in the theater of conflict.

Secondly, as a modern force, it should have extensive command and control networks allowing communications over great distances that extend down to the lowest levels of the force. Furthermore, these communications should rely on encryption and other new technologies making them difficult to intercept and jam.

Thirdly, TAFs should have elegant intelligence and surveillance assets that make the battlefield increasingly transparent. Use of space-based assets, increasingly sophisticated unmanned systems, technologically advanced aircraft, and even highly capable robots and remote sensors should give the commanders capability to see their forces and those of their enemy with unprecedented clarity in almost real time. When combined with the ability to precisely locate one's own position and that of the opposition, this will create an exceptional degree of situational awareness which will free military leaders from wondering what is happening on the other side.

Finally, TAFs should have the ability to operate at great distances and deliver precision munitions while doing so. It is vital that it should have precision munitions that have a wide search area, automatic target recognition, and the ability to attack moving targets with the same accuracy currently seen in attacks against fixed targets.

C. TURKEY'S DEFENSE POLICY AND MILITARY STRATEGY

The threats and risks of Turkey's security in the post-Cold War era are different from those in the past. At the end of the Cold War, there was a search for new-world order. Most of the risks and threats have changed since then. However, the concept of threat is obviously evident and it has become multi-directional, multi-dimensional, and variable and instabilities dominate the environment. The traditional concept of threat started to emerge in the form of [Ref 50. p.45]:

- Regional and ethnic conflicts,
- Political and economic instabilities and uncertainties in the countries,
- Proliferation of weapons of mass destruction and long-range missiles,
- Religious fundamentalism,
- Smuggling of drugs and all kinds of weapons,
- International terrorism.

As mentioned before, Turkey is located at the center of the triangle of the Balkans, Middle East, and Caucasus. In this region, there are new threats and risks. This is the region where the

interests of the global powers and formations intersect. This situation has not changed and will not change in the 21st century. The importance and the role of Turkey will become more strengthened in the new-world order.

Turkey's defense policy is directed at defense due to its natural characteristics. It is prepared to protect and preserve independence, sovereignty, territorial integrity, and vital interests of the country. For this reason, the following are the targets of Turkish National Defense Policy at the beginning of the 21st century as a requirement of this new century [Ref 50. p. 48]:

- To contribute to peace and security in the region and to spread this to large areas,
- To become a country producing strategy and security that could influence all the strategies aimed at its region and beyond,
- To become an element of power and balance in her region,
- To make use of every opportunity and take initiatives for co-operation, becoming closer and developing positive relations.

Turkey is subject to multifaceted threats due to its geo-political and geo-strategic position. For this reason, the formation of a military force structure is of great importance to Turkey. Turkey should maintain and develop this force according to the conditions and periods. As a result, attaining the military power, which has the resources and capabilities of supporting the National Security Policy, constitutes the basis for Turkey's National Defense Policy and strategy in the 21st century.

Turkey's military strategy consists of the following four important matters that support the specified defense policy [Ref 50. p. 55]:

- Deterrence,
- Military contribution to crisis management and intervention in crises,
- Forward defense,
- Collective security.

Maintaining a military force that provides a deterrent influence on the risks and threats is the foundation of the National Military Strategy.

In the crises concerning Turkey, the peaceful solution of the disagreements through diplomatic, economic, and other crises management measures is one of the most important elements of the military strategy.

The contribution of TAFs to the international efforts for the solutions of crises is one element of the military strategy that cannot be relinquished.

When subjected to an external aggression, stopping it as soon as possible constitutes the foundation of forward defense.

D. INTERNATIONAL DEFENSE INTERESTS

The collapse of communism in Eastern Europe and the disintegration of the former Soviet Union have created a new set of strategic challenges facing the USA and its European allies,

including Turkey. The focus of strategic threats and challenges has changed and poses new policy dilemmas for the US and European policy makers. How well western powers and Turkey succeed in addressing those challenges will have a significant impact on the future of security, especially in Europe. This is particularly true in the case of the Caspian Basin and the Middle East. Both areas are emerging as critically important in the effort to create a stable post-Cold War security order. Indeed, the energy-rich Caspian region could become the focus of a rivalry between Russia, Iran, and Turkey.

While Turkey's strategic importance is understood by the USA, Turkey's relations with Europe has been more difficult and problematic. As long as the Soviet Union was perceived as a major threat, European powers gave Turkey a high priority in Europe's relations with Turkey.

The end of the Cold War has reduced Turkey's strategic importance for Europe. At the same time, economic, political, and cultural issues have become more important in Europe's relations with Turkey. Today, the main European concern is not deterring the Soviet threat, but creating an economic and monetary union and forging a common European foreign and security policy [Ref 54. p.158].

Moreover, European efforts to create a distinct European security and defense identity threaten Turkey's isolation from Europe. Turkey is a member of NATO but not a member of the European Union. Thus, it does not directly participate in the debate on European defense and security policy.

Turkey had always been considered an important US ally. However, with the end of the Cold War, the focus of US interests has changed, too. During the cold war, Turkey was important because it served as a bulwark against the expansion of Soviet power into the Southern Region (the Mediterrenian Basin). Turkey is important in the post-cold war period because it plays a critical geo-political role in three areas that are of increasing strategic importance to the USA: the Middle East, the Balkans, and the Caspian Basin (the Caucasus and the newly-independent Turkish Republics). In each of these areas, Turkey's cooperation is critical to the achievement of broader US strategic objectives [Ref 54. p.151].

The US-Turkish agenda has changed since the end of the Cold War. During the Cold War, it centered primarily on Turkey's role in Europe, in containing the expansion of Soviet power into the Mediterrenian and tying down Soviet troops that might otherwise be used on the German Front. After the end of the Cold War, the key

issues focus on Operation Provide Comfort and Northern Iraq, the Caspian pipeline, the Balkans, and Iran.

E. CIVIL-MILITARY COOPERATION

Improved civil-military co-operation is vital to the success of future joint operations of civilian and military sector. Coordination and cooperation are dependent on a series of key factors, including proper communication and consultation, and/or understanding of each other's cultures, and organizational structures.

Various cultures and ideologies of different organizations even in the same country have a significant impact on the degree of civil-military cooperation. This is a problem, which has been emphasized by past and present civilian sector people and by military personnel.

Different organizational structures hamper cooperation and coordination on several grounds.

Communication breakdowns including incompatible equipment or lack of agreed communications procedures within both the civilian and the military sectors damage the operations carried out mutually by civilian and military sector. The use of incompatible communications equipment (field phones, satellite phones, short wave radios) may be a prevalent problem for cooperation. For example, military sector has more technically advanced equipment

than civilian sector in Turkey and this affects the efficiency level of the cooperation.

There are many targets for expansion of cooperation between the civilian and the military sector. For Turkey, targets of the Turkish civil-military cooperation are mentioned in the White Book published by Turkish Ministry of Defense [Ref 50. p.63]:

- To continue the functions of the government in times of crisis and war,
- To perpetuate the social and economic life,
- To provide for the protection of the people against the threats and risks stemming from war and disasters,
- To facilitate reconstructing after attacks,
- To contribute to the efforts of NATO/European-Atlantic Partnership Council continued at an international level,
- To provide for the rehabilitation of the disaster regions.

In natural disasters, such as earthquakes, floods, avalanches, landslides, and large fires, military sector supports the civilian sectors. There are many examples of these kinds of supports. The best and up-to-date example is the earthquake in 1999. Military units were the first and foremost ones from government sector for help to the people of the damaged areas.

In case of mobilization or war for Turkey, the civilian sector would support the military sector. At times of security crises or war, all kinds of communications and transport equipment that belong to the public and private organizations would be given to the military sector.

The cooperation between the civilian and military sectors in Turkey includes various fields. These extend from local to central authority. One possible field would be the preparation of plans, procedures and principles related to mobilization and preparation of war. The determination of priorities in the planning of the natural resources related to the needs of the TAFs, public and private sector could be a field for cooperation.

Several steps could be taken to improve future joint missions. There are comprehensive and various administrative instruments in Turkey facilitating joint missions that are in effect now. Moreover, greater cooperation, coordination and reduced negative perceptions could be achieved through cultural sensitivity training, reforms to present coordination mechanisms, and greater understanding and respect for the differing organizational structures and cultures involved. One specific reform could include the creation of joint or linked training manuals.

F. DEFENSE INDUSTRY POLICY AND STRATEGY

The Turkish defense industry has made significant progress in restructuring the domestic defense industry. Based on this concept, a "Defense Industry Policy and Strategy" was prepared that envisioned all the defense industry and procurement activities to be conducted according to a comprehensive plan. The objective of the

policy was to form a defense industry infrastructure that has the following characteristics:

- Open to the foreign sector as well as the local sector,
- Having a dynamic character, export potential and international competitiveness,
- Easy adaptation of new technologies,
- Making maximum use of the existing capabilities,
- Capable of production for civilian purposes.

During the next 20 to 30 years, a great part of the combat weapons and equipment in the TAFs' inventory should be modernized or replaced with systems that incorporate new technology. The cost of all these systems including their operation and maintenance is very high. Turkey's objective in modernizing the TAFs is to raise the Turkish Defense Industry to the level where it can produce the high technology weaponry and equipment needed by TAFs. Domestic production should be used to the maximum extent possible. In case of foreign procurement, priority should be given to those countries who advocate Turkey's long-term political interests in the international arena of equity, and who facilitate sales to third parties.

In defense industry sector, Turkey is engaged in cooperating on bilateral or multilateral basis with a wide range of countries including NATO members, Middle East, and Far East countries. For example, Israel is one of the partners. Israel is a country with a vast experience in defense industry. It possesses advanced technology that results in the production of the state-of-the-art weapon systems.

Moreover, it is ready to share its experience and expertise with Turkey [Ref 55. p.3].

In short, while preparing the TAFs for the challenges of the 21st century, Turkey's basic objective should be to have a defense industry that has a national character to the maximum extent possible and that enables Turkey to compete with modern countries in its area.

G. TURKISH ARMED FORCES' TEN-YEAR PROCUREMENT PROGRAM

In 1997, the Turkish Defense Ministry revealed a $31 billion defense modernization and procurement program for the next decade, in an attempt to strengthen its armed forces.

Defense Ministry planned to spend $31 billion between 1996 and 2007 on the modernization of the Turkish Armed Forces under the Ten-year Acquisition Program concept [Ref 56].

The program foresees the acquisition of thousands of armored combat and wheeled tactical vehicles, more than 100 attack helicopters, a tank-project, air-refueling and early-warning aircraft, warships, missile systems, communication and satellite systems, and modernization programs for fighter jets.

It was the first time that such a detailed and complicated defense program had been announced. The Ministry of National Defense pointed out that they would present this program to the

private sector and to entrepreneurs in an effort to draw their attention to the defense sector.

The Ministry of National Defense indicated that by means of such presentations, the private sector could be made aware of projects setting up investment policies for involvement in Turkey's defense industry. In this way, the domestic companies' share from Turkey's defense projects would increase.

Defense Ministry stated that they would provide financial support as an incentive for local companies, who were willing to become involved in these projects.

All the projects would be started with the aim of meeting the needs of TAFs from within Turkey trough technology transfer.

However, because of the latest economic crises in Turkey, the Turkish Armed Forces have begun reviewing the projects included in the ten-year-procurement program [Ref 57].

TAFs were already negotiating with US-based Bell-Textron on a $4 billion contract for attack helicopters. TAFs were also discussing the purchase of six AWACS from Boeing, and planning to buy 1,000 tanks.

In April 2001, TAFs have announced that most of the projects that would be carried out in the program would be cancelled until the success of the latest economic program. However, TAFs

continue to consider and plan to carry out the projects as possible in the foreseeable future.

H. EFFECTS OF TURKISH NATIONAL DEFENSE STRATEGY ON DEFENSE INDUSTRY

As mentioned before, the threats and risks to Turkey's security in the post Cold War have changed. At the end of the Cold War, there was a search for new-world order. Unlike the Cold War period, Turkey now faces with a different set of security threats, risks, and challenges, which require new thinking and new approaches.

Turkey is in a place that can be virtually called a "Bermuda Triangle," with the Balkans, the Caucasus, and the Middle East [Ref 58]. Because of the needs of its position in such a place and the threats and risks it faces, Turkey has different sets of national defense strategies. For this reason, the formation of a military force structure is of great importance for Turkey. Turkey should maintain and develop this force according to the conditions and periods. As a result, attaining military power, which has the resources and capabilities of supporting the National Security Policy, constitute the basis for Turkey's Defense Policy and strategy in the 21st century.

For the reasons mentioned above, the modernization of the TAFs is imminent and this modernization would be set up by a

construction of the infrastructure of a modern domestic defense industry.

After the establishment of the Under-Secretariat For The Defense Industry, the task of coordinating efforts for the modernization process has accelerated, and defense equipment has been produced domestically to some certain extent. The level of inventory of TAFs with respect to weapons, vehicles, and other military equipment are powerful illustrations of the operations undertaken by the national defense industry.

If allocated enough funds today, Turkish defense industry is capable of meeting a significant part of the requirements of the TAFs. Systems produced for TAFs and the success of the Turkish companies on the international market reveal that Turkish defense industry is advanced and can compete in international markets [Ref 55. p.4].

However, it should be pointed out that development of highly advanced military systems is currently beyond the capabilities of the national defense industry. This problem could be solved only by investing in research and development and making technology transfer by using offsets or joint ventures from advanced countries in defense industry such as Israel and USA. Defense industry cooperation with other countries is of the utmost importance to Turkey's national interests.

The Under-Secretariat For The Defense Industry is established for the sake of improving the infrastructure of defense industry in Turkey. However, it also takes into account the needs of the public sector and the needs of other state institutions.

Even though the development of the national defense industry has not reached its desired level, the path covered in 16 years is a reason to be proud for the nation as a whole. Within the past 16 years, Turkey has been able to export its products to every corner of the world in the fields of defense electronics, rockets, aviation, and armored vehicles [Ref 55. p. 4].

The agenda of the defense industry increases with the new projects parallel to the requirements of the TAFs. Moreover, the quality and the low cost of the products have a positive effect on the economy as a whole. It is obvious that this positive atmosphere will continue in the middle and long run.

I. DESIRABLE CHARACTERISTICS OF FUTURE DEFENSE INDUSTRY

In the future TAFs must be engaged in the areas where Turkey's interests are. For this reason, it should be sufficiently mobile and capable of supporting operations both within and outside of Turkey in case of need. Turkish security planners should stress emphasis on high-performance weapons.

For the reasons mentioned above, TAFs should preserve and gain the following characteristics for the new century [Ref 53. p.81]:

- Smaller, active and ready reserve forces,
- Less forward basing, greater strategic mobility,
- Having and continuing weapons performance advantage,
- Substantial nuclear, chemical, and biological capability,
- Chemical, and biological defense capabilities,
- Greater dependence on mobilization.

After pointing the future characteristics of TAFs, future characteristics of a national defense industry should be determined. These characteristics should be in relation with and supporting the needs of TAFs in the 21st century. Future defense industry should be affordable in development and peacetime acquisition of high-performance weapons. Moreover, it should be responsive in production of weapons and supporting equipment for use in any crisis or war. National defense industry characteristics should be as follows [Ref 53. p.81]:

- Advanced research and development capability,
- Ready access to civilian technology,
- Continuous design and prototyping capability,
- Limited, efficient peacetime engineering and production capabilities in key defense sectors,
- Responsive production of ammunition, spares, and consumables for theater conflict,
- Healthy, mobilizable civilian production capability,
- Robust maintenance and overhaul capability,
- Good, integrated management.

Constructing and having a nationally advanced research capability should be the highest priority. The need to have high-

performance weapons and guard against technological surprise necessitates a robust research and development capability. The research and development component of the defense industry should consist of some combination of private and public sector funding.

The future defense industry base should be flexible and research-intensive. It should be integrated with the civilian sector and industry. It should retain its orientation towards high technology and high-performance weapons.

Moreover, Turkish policy makers should give importance to constructing an autonomous defense industrial base within affordability constraints. This defense industry base should be capable of furnishing the full range of materials required by TAFs. Those military systems that would be produced internally should be at affordable cost.

J. EUROPEAN UNION AND TURKISH DEFENSE INDUSTRY

In the framing of a common defense policy, Treaty of the European Union allows for the Member States to cooperate in the field of armaments. But other rules exempt defense industries from the (Europe Union) EU laws that regulate competition in other sectors of the common marketplace [Ref 60]. This means that EU countries can enact measures that will protect their domestic defense companies from external competition. In addition to this,

procurement is undertaken on a national basis, from national defense budgets. As a result, fragmented procurement polices, redundant research and development (R&D) programs, and widely varying export control standards contribute to an overall level of inefficiency, which ultimately makes it difficult for European defense companies to compete with American products.

Unless Europe coordinates its defense acquisitions, American defense companies will continue to dominate the European market and will eventually push European companies out of business [Ref 61]. Moreover, the attempts by European governments to protect their indigenous industries through preventing the adoption of a single European market in defense has increased the threat of European companies becoming sub-contractors to the American defense industry companies. Because of the large US defense budget and because the US government is able to fund large acquisition packages, it is able to support longer production runs and achieve an economy of scale that would be otherwise impossible in Europe. The adverse result of the disjointed acquisition practices in Europe means that it is even more difficult for European governments and industries to cope with the rising costs of advanced technology. Thus, European defense companies are unable to compete with American companies that are able to offer cheaper and more cost efficient products for export. When all of these elements are added

together, it is ultimately more expensive to fill in the defense capabilities gap.

TAFs is dependent upon the foreign contractors especially for the advanced weapon systems. Up to 2000, Turkey acquired most of the military systems from the companies usually working in USA. The dominance of those companies in the technological advance and cost of the systems usually caused such an inclination in weapons acquisition of TAFs. However, European countries and their defense sector companies has been an important partner in the acquisition process. If the Europe based companies achieve a better way of competition with their US counterparts, Turkey could shift its arms procurement process from US dominance towards Europe.

The membership of the European Union has been an important issue for Turkey since 1960s. After entering the Customs Union in 1994, it continuously pursued that goal. However, it is not likely that Turkey will achieve that goal in a short period of time. What Turkey wants to achieve with EU is to be technologically advanced and competitive in every field of economy, including the defense sector.

Turkey's involvement in the projects carried out by the European defense contractors help it advance in the technology field. However, Turkey also continues to interact with the USA-based companies and with Israel. What Turkey should do is to use

the weakness of competition of the European defense market with respect to US companies and Israel and to continue its efforts to build a national defense industry. The consolidation and the competition weakness of European-based defense contractors should not affect Turkey's goal of optimizing its national defense industrial base.

Turkey should acquire the advanced weapon systems in a cost effective way. It should follow a policy that would allow the easiest way of technology transfer from abroad. This kind of technology could be either in EU or in USA. Then, to have the best systems in use, the origin of the companies is not a matter to be considered: only the cooperation and the technology.

VIII. ARMING THE FUTURE

A. STRATEGIC CHOICES FOR THE FUTURE BASE

To accomplish the desired characteristics of the future Turkish Defense Industry and Technology Base (TDITB) outlined in the previous chapter, Turkey should generate a long-term defense industry and technology strategy for identifying, developing and maintaining the critical facilities, technological know-how, and people needed to develop, manufacture and maintain future systems and to provide a core for resurgence of production in any future emergency.

At the national government level, resource allocation involves choices between competing national priorities. Policy-makers must choose between allocating money for defense or for competing social needs such as health care, the old dichotomy of "guns versus butter." Having decided on the allocation of resources, decision-makers must then structure the use of defense funds by developing an overall strategy for the various government agencies with national-security responsibilities.

There are three broad strategic choices that should be carefully evaluated to define a well-reasoned defense-industrial strategy for arming the future of Turkey:

- The degree of international interdependence versus national autonomy

- The degree of reliance on the integration of civilian and military sectors versus an arsenal approach, and
- The allocation of resources between maximizing short-term military power versus acquiring the potential to develop and produce new weapons and defense equipment when needed.

Improvised decisions, made in the place of a strategy, will most likely result in a weak TDITB that will weaken Turkey's defense. In practice, Turkey should not pursue any one strategic choice to the complete exclusion of the others. Instead, the various defense industrial sectors should be positioned along a continuum according to a weighing of the risks and benefits of applying a particular strategy.

1. International Interdependence vs. National Autonomy

If Turkey remains weak in a critical military technology, the purchase of a weapon system or component from the best available foreign source creates a dilemma, since in making the purchase Turkey might improve its short-term military power but may weaken its long-term defense technological potential. From a standpoint of being concerned about the health of the domestic defense-industrial base and increasing Turkish international industrial competitiveness, adopting a "buy national" strategy that concentrates Turkey's limited funds on domestic industry might look like a feasible solution. This is due to the fact that foreign-sourcing can wear away the current capabilities of the TDITB and

delay Turkey's efforts to gain new capabilities. It also makes it more difficult to shift resources from the civilian to the defense sectors as domestic firms might go out of business. Moreover, foreign-sourcing can weaken Turkey's defense capability if foreign firms are less responsive to Turkish defense needs than are domestic producers. On the other hand, procuring most or all weapon systems and defense material from domestic producers can reduce the risk of supply cutoffs during a crisis, free domestic suppliers of services and equipment from the threat of unfair foreign competition, and increase the demand for domestic defense products, thus potentially increasing the national industrial productivity through larger production runs and more funding for technology development.

However, the key national-security consideration should not be total foreign content, but foreign vulnerability related to critical technologies or products [Ref 62 pp.1-15]

The alternative strategic choice will be the increased interdependence with allies, especially the U.S. and other NATO members. This strategy recognizes both the ongoing globalization of the technology and industrial base and the increasing cost of developing new weapon systems. The inauguration of industrial globalization implies an interdependence of allied nations for the technologies and even the components of defense systems. Given the constraints on defense spending and Turkey's crucial need for funds

to revive the domestic economy, Turkey should consider concentrating on developing and manufacturing critical weapon systems domestically while exploiting the benefits of collaboration with foreign sources for some of its requirements in other areas.

Advantages of international interdependence might be to create a more competitive environment, ultimately decreasing the price of military products; to facilitate standardization and interoperability of weapons with allies; and, to assure access to the best technologies as new scientific developments take place around the world. Even with an increased international interdependency, Turkey should develop and preserve selected critical technologies for reasons of national security or industrial competitiveness. Especially, the capability to design and produce, if necessary, the major weapon systems should be attained and maintained, even if current economic conditions might favor foreign-sourcing. Major weapon systems include fighter planes, ships, submarines and armored combat vehicles/tanks.

2. Arsenal System vs. Civil-Military Integration

A second choice relates to the internal structure of the base. There are two alternatives: On one hand, Turkey can rely on arsenals, either government or privately owned, that might be sole-source producers of particular military systems. (Arsenals are

usually considered to be government-owned facilities that manufacture military material. However, the arsenal system is composed of either government facilities such as MKEK, or private firms that might be sole-source producers of a particular defense technology, such as TAI). On the other hand, Turkey can modify its military requirements to match what might be available from the commercial sector and move toward a more integrated national industrial and technological base.

An arsenal system, composed of a combination of government-owned facilities and sole-source private firms, might allow efficient development and manufacturing of military-unique equipment. Such a strategy will concentrate on establishing and maintaining a limited number of expert sources of weapons and equipment and will restrict competition for government contracts to those firms and public facilities with recognized skills. The French defense industry is one example of an arsenal system in which companies, referred to as National Champions, have been the sole producer of defense-only products. An arsenal system might allow Turkey to develop and conserve needed expertise that can then be expanded in a crisis; to improve the efficiency of bid and proposal for contracts; and, to increase the stability of the production. However, in the absence of full and open competition, this strategy will require different ways to be considered to control costs and foster innovation.

The alternative choice is to place greater reliance on the integration of civil and military sectors, buying civilian parts off the shelf and using more civilian technology and procedures. This strategy might lower costs of weapon system development and production by using readily available technologies and products; it could result in an improved and increased mobilization capability against a major threat. Eliminating unnecessary military specifications might result in lower costs for parts purchased directly from commercial suppliers, and might attract more companies into the defense work. On the other hand, increased reliance on the civilian base might include reduced performance edge of weapons over those of potential adversaries. Moreover, commercial parts might not be capable of performing with high reliability under severe combat conditions.

Civil-military integration should be pursued on a case-by-case basis. The choice of an arsenal system or civil integration is also highly dependent on the industrial sector in question. For example, nuclear weapon systems will always have to be built in arsenals. Major weapon systems such as armored vehicles, tanks, fighter aircrafts, ships and submarines might also be built in arsenals as well, but electronic components and a host of other components might be better sourced from the civil sector. More diversification into civilian markets and more integration between civilian and

military products might also help defense firms withstand fluctuations in defense spending.

The future is likely to bring out an environment in which nations maintain only a very few defense-unique sectors in the economy for technologies that are specific to defense, such as nuclear weaponry. For most defense needs, they would have to cooperatively link up with the commercial sector for research and development and for acquisitions of materials, components, and equipment.

In Turkey's case, it is very unlikely that the Turkish domestic market for major weapon systems will be large enough to support more than one producer in each of the major sectors. Therefore, it might be a very good strategy to create arsenals at the prime contractor level for major weapon systems, which will dominate the domestic defense business in their sectors, and each should be the sole depository of design and systems-integration know-how for an entire category of defense equipment. In such a structure, the Undersecratariat for Defense Industry should be responsible for imposing administrative controls on price and quality, while simultaneously cooperating with industry to maintain profits, employment, and investment in new technologies. The effective administrative controls must help ensure that the lack of domestic competition at the prime-contractor level does not result in out of

control costs. Since the TAFs are the single dominant customer for defense products, administrative controls on quality and costs will be more appropriate than relying on market mechanisms such as competition. These arsenals should be closely monitored and encouraged to stay in close touch with the rest of the national industrial base and to employ the new technologies and the readily available commercial products in developing and producing the so-called weapon systems. The arsenals should be encouraged to compete in commercial ventures or international defense competition to encourage them to aggressively control costs.

3. Short-Term Military Might vs. Potential Capability

Another choice concerns the allocation of resources between expanding current military capabilities and future defense potential. Decisions must be made between procuring current weapons and spending more on research to develop technology and industrial infrastructure, which will provide Turkey with capabilities for future weapons, without any commitment to full production, and ultimately between spending on the military and other national needs.

While it may be necessary in a fiscally constrained environment to retain only the potential for manufacturing enough sophisticated platforms, such as the most advanced aircraft and

armored vehicles needed to fight a major conflict, there is still a requirement to have sufficient fielded weapons, including aircraft and tanks, to support warfare contingencies. These deployed weapons will be a product of the limited peacetime defense production base and they will be upgraded with new components as necessary until a new technological breakthrough or aging of the systems prompts modernization.

The approach of maintaining future military potential in the face of sharply reduced defense budget is currently termed as "research strategy." Such a strategy covers a range of possibilities. In the simplest terms, it means spending proportionally more on R&D and less on production. But increasingly radical approaches are also imaginable. An alternative might be to build a limited number of demonstration models with hard tooling (stamps and dies designed to serve for a long production run of one particular part) on an actual production line to prove manufacturing concepts and allow field testing –after limited production, the line will be shut down, whereas, another strategy might call for the production of demonstration models with soft tooling (less durable and specialized, but enough for making only a few items), without proceeding to develop an actual production line. Yet another extreme case of research strategy might involve no prototype be built. Instead, designers might develop components and use

computer-aided design techniques to test concepts and develop technical data packages that can subsequently be produced when needed. While this type of "research strategy' is many years from being a practical reality, manufacturing technology is moving in that direction. Computer-aided design, computer simulation of operational environments, a design philosophy emphasizing high reliability and ease of maintenance, and automated flexible manufacturing will all make this type of research strategy a more practical alternative.

Each of the research strategy alternatives has certain limitations. Moving along the spectrum from production to pure research lower costs but increases risk and uncertainty. Without actually working out the manufacturing process, it might not be possible to foresee all the roadblocks standing between an idea and the actual production run. Thus, while building prototypes can reduce unforeseen problems with systems integration, building one or two prototypes might tell very little about serial or large-scale production, operational use, maintenance, and reliability.

Moreover, the potential of many past weapon systems and logistics support were not fully appreciated until enough of them had been deployed to allow military commanders to experiment with them in field exercises or on the battlefield. A process that generates a continuous flow of hypothetical weapons will never

allow military commanders to develop optimal tactics for using them, nor provide logisticians the capability to support them, nor will it allow the military bureaucracy to assimilate new weapon systems prior to a major conflict.

Currently, the weapon systems and other defense equipment in TAFs inventory are one of the oldest among the allies in NATO and the costs to maintain these systems and equipment has been increasing exponentially. Therefore, Turkey is in dire need of replacing or at least upgrading its current inventory of weapons and military equipment. Apparently, some might argue that the escalating insecurity in the environment surrounding Turkey and its national interests necessitates the immediate foreign-sourcing of new systems and equipment. Even in doing so, the Turkish government should require the potential sellers to set up production facilities in Turkey and transfer technology. Foreign producers should be asked to establish laboratories and training centers as part of the production facilities to educate and involve domestic work force and engineers in designing and producing future systems. A plain purchase of weapons and other defense equipment will not only hinder Turkey's gaining of military technology, but also will waste the nation's already limited resources with no future benefits.

Another option to respond to the immediate needs of the armed forces might be to skip the current generation of the systems, by

only upgrading the current systems in its inventory. This can extend the service lives of these systems for another 7-10 years, and allow the country to channel the funds to R&D programs. These programs should be aimed to develop the technology and production infrastructure, which will be used to design and produce the next generation of weapon systems and defense equipment. This option can accelerate Turkey's efforts to close the gap between its domestic defense-industrial capabilities and world-class defense sectors. Moreover, the level of funding, created by deferring the acquisition of new systems, might also contribute to national industrial base by using dual-use technologies and increased civil-military integration.

B. TACTICAL DECISIONS

Having decided on the strategic issues, Turkish policy-makers will need to elaborate on the following tactical decisions involved in achieving the desirable characteristics of the future base. These decisions will occur within the context of the broad strategies discussed above.

1. Shifting Emphasis From Production to Advanced Research and Development

A robust domestic defense industrial base will require an advanced R&D capability that can 1) maintain qualitative weapon

performance superiority against potential adversaries; 2) create opportunities for innovation and hedge against technological breakthroughs by opponents; and 3) support Turkey's overall economic strength and industrial development, which is ultimately the source of its military strength.

An advanced defense R&D capability includes world-class personnel (individuals and teams); cutting-edge research that guards against technological surprise; vigorous efforts in critical technologies; a balance between the near-term technology needs and long-term national defense needs; strong links to manufacturing, so that proposed weapon systems are producible; and integration with civilian R&D.

The advanced R&D capability of the base should be embodied in the dedicated defense base and the larger civilian base. Expanding and maintaining this capability requires the retention and replacement of skilled R&D personnel; the identification of core competencies; and the development of new ways to discipline, guide, and evaluate R&D within a streamlined defense R&D establishment.

a. Organizations and Activities

The research and development component of TDITB might include industry laboratories, government laboratories and

test facilities, and ultimately, university research centers that conduct research relevant to defense.

As a very rough rule, universities might tend to concentrate on basic research, government laboratories on applied research, and industry on development and engineering. The research phase involves investigating new technologies that have a variety of applications; when a specific application is in sight, development and engineering work is required to incorporate the technology into a product. The purpose of the exploratory and advanced development stage is to obtain information about the design and engineering of a new system so that a decision can be made to enter production with adequate confidence about schedule, performance, and cost.

b. Funding Research and Development

The resource requirement for research and development can be funded through different ways. Industry firms can fund their activities either from direct government R&D contracts or from company profits generated through sales of goods and services. For example, while the government may provide a company with a contract for the development of a system, the company may also contribute substantial amounts of its own money, which can be justified if the development leads to a profitable production contract. Government can also allow contractors charge some

fraction of their R&D expenses against ongoing contracts, i.e. companies can charge some of their R&D as an allowable reimbursable expense, an element of overhead necessary to stay in business. By doing so, however, Government must define and approve the general research areas and amounts as to which R&D expenses will be reimbursed. Government should also encourage universities to be involved in defense related R&D by providing them with funds to set up advanced laboratories, and by granting research funds to universities, which can also contribute to national science and technology base. Finally, it should be remembered that there is a close link between R&D and production. If the government wants to maintain R&D in spite of reduced procurement level, then R&D must be made profitable in its own right. If the government opts to continue R&D in its own laboratories, it has to make the results of R&D widely available to the industry in order not to exacerbate the separation of research and production.

c. Managerial Guidance

Currently, there is no organization, governmental or non-governmental, that manages the R&D component, which is very small in size, of TDITB. In fact, there is very little R&D in defense field. However, it is of vital importance to establish an agency that will direct the research and development component of TDITB by monitoring and coordinating the nation-wide defense-related R&D

activities, establishing priorities, funding research carried out either in government or industry laboratories and managing collaboration with the armed forces. It should monitor the other research by the national laboratories in non-defense fields (energy, electronics, etc.) to maintain a pool of scientific and engineering talent and knowledge that could be helpful for meeting future military needs. The new agency, like DRET of France, DTI of South Africa or DARPA of US, should be responsible for monitoring defense-related developments in science and technology not only within the country, but also outside Turkey, and bringing them to the attention of technical directorates, users and contractors. It should encourage the defense industry firms to engage in R&D activities that (1) strengthen TDITB, (2) enhance Turkey's industrial competitiveness, (3) promote critical technologies, and (4) support dual-use technologies. It should also define nation's defense research priorities on an annual basis. The new agency should have the flexibility and responsiveness to shift defense-research priorities to the emerging security environment. Defense Industries Research and Development Institute (SAGE), which is an affiliate of The Scientific and Technical Research Council of Turkey (TUBITAK), might be the best candidate for this mission. Even though it has very limited resources and capabilities, this institution might easily be transformed into such an agency and, if

funded sufficiently, could easily carry out the above mentioned requirements, with its close ties with Turkish R&D community in general and limited experience in defense R&D.

d. Human Resources

An advanced R&D capability requires qualified human resources, which are the key to a nation's defense R&D capability. Strategies for attracting and retaining good research and development personnel should include higher pay, a challenging work environment, and job security. Over the long term, interesting and challenging work is the most important motivation. Thus, even during times of economic crisis or defense cuts, it is necessary to maintain meaningful work for defense R&D personnel, possibly through research grants and programs not directly tied to production. In times of budget cuts and shrinking market, laying off quality personnel might yield quick savings but, in long-term it may endanger the design and manufacturing capabilities of the base. In fact, Turkey needs to develop not only its defense R&D base but also the national science and technology base. Currently, it is one of the countries with the lowest funding for R&D activities and badly in need of an advanced research and development base. Only about 2 percent of the defense budget is allocated for the financing of defense research activities in Turkey. Moreover, in order to access civilian technology and to the R&D personnel employed in the

larger mobilizable civilian base, Turkey should closely monitor and maintain R&D capabilities in dual-use areas such as aerospace, electronics, and advanced materials, all of which are critical to designing next generations of military and commercial systems.

e. Identifying Core Competencies

Another important step in creating a national advanced defense R&D capability is the identification of core competencies. Turkey should immediately identify and prioritize the technologies for which it should maintain a domestic knowledge base in the face of growing resource constraints and international competition. Identifying such "core competencies" that are critical to its economic health and military security can also assist the government in adequately funding a small number of truly vital areas of R&D with limited resources. It also helps in concentrating the defense R&D efforts in those sectors that are both of critical importance to military systems and not available elsewhere. For example, it may be necessary to abandon defense electronics R&D in those areas where civilian sector can be depended on to improve performance, such as higher speed and smaller size, and concentrate on those areas where no civilian R&D is taking place. As a result the country will need to place greater emphasis on civilian R&D. Similar arguments hold with respect to foreign-sourced technology. Turkey may have to focus its R&D efforts on those technologies

deemed to be critical, while placing greater reliance on allies and international industry in other areas.

f. Maintaining Competition

Competition in R&D might be used to promote innovation and impose discipline for greater cost efficiency. But while competition must continue in defense R&D, during a period of severely limited defense funding, it should be structured differently. Rather than competing laboratories, there might be competing design teams at the same laboratory. Similarly, in the private sector, a few lean design teams with associated manufacturing capability can be maintained for each major type of weapon system or technology. And, instead of domestic competition among Turkish firms, there might be international competition, with Turkey relying on a single domestic source in competition with other world-class producers. One major question is whether to focus on weapon performance rather than manufacturing, reliability, and product maintenance. Trading some of the performance for improved reliability, lower-cost manufacturing, and reduced maintenance requires changing the incentive structure to make other design goals as important as performance in the overall development process.

g. Developing Design and Prototyping Capability

A key element of the future TDITB will be a continuous design and prototyping capability that can operate with reduced

R&D spending in the face of curtailed production. The extent to which designs are carried through to manufacture will depend on whether there is a technological development that provides a significant operational performance advantage. Some prototypes will lead to force modernization, while others will simply advance the state of knowledge within the defense technology base.

Like R&D in general, the capability to design and develop new systems rests largely with people, namely the design and engineering teams essential for the development of modern weapon systems. These teams may vary in size according to the complexity of the system and the stage of development. For example, design teams for a modern fighter aircraft can grow from a half dozen people in the initial conceptual design phase to a few hundred to a thousand engineers with a variety of skills during prototype development and testing. The size of the design teams also varies considerably by product and can apparently be kept small without undue harm to design quality.

The idea of having a design and prototyping capability that is not directly linked to production might be criticized as impractical partly because good design teams are unlikely to continue to work without seeing any tangible results, and partly because the design process needs an occasional 'reality check". In fact, these are not undefeatable obstacles. Scales prototypes can test

technological innovations, keep design teams interested, and allow them to be ready when new requirements arise.

Overall, Turkey should focus on defense research and development, and increase the government funding and encourage private sector to commit more funds into R&D. Although commercial and defense R&D are budgeted and administered separately, defense R&D benefits the overall economy. In addition to contracted R&D, the government should draw on independent research conducted by defense companies. A portion of these R&D expenses should be reimbursed as overhead costs on defense contracts. All of these efforts will advance the country by allowing companies to stay current in critical areas of defense technology, encouraging technical innovations, and giving government scientist and engineers valuable insights into ongoing industrial research.

2. Efficient, Responsive And Mobilizable Production

In the face of demand for lesser defense expenditure and increased instability in the security environment, Turkey should make several tactical decisions to establish an efficient, responsive and mobilizable production base. Among these are the determination of production planning, which requires a tradeoff between efficient peacetime production of weapons and wartime responsiveness and the formation of the acquisition system, which might lead to the

isolation of defense producers from the rest of the national industrial base if not addressed properly.

a. Identifying Critical Areas

Initially, the strategy for future TDITB should identify the critical items of defense equipment that might be required for future short-notice contingencies. Then, the capacity to design and produce these vital defense materials should be developed and preserved to meet those needs. Nevertheless, it should also be recognized that starting up the production of vital defense materials quickly and achieving effective and efficient production depends on the amount of parts and components that have been stockpiled for future contingency-production.

Since much of the defense production efforts is generally in sub-tier firms, maintaining industrial responsiveness entails either preserving critical sub-tier capabilities or allowing vertical integration to occur as prime contractors bring more subcontracting in-house, possibly by not requiring the second-sourcing of spare parts. However, in the Turkish case, vertical integration of defense industries is not desirable and Turkey should seek to maintain a diverse vendor base of competing subcontractors and suppliers, many of them small and mid-sized firms. Competition should be sought at the level of subcontractors and suppliers.

Establishing a small responsive base of the type envisioned requires identifying critical areas of defense production, setting priorities, and funding a surge capacity in the identified areas.

b. Surge Capacity

Under the current security conditions, surge production capacity should be limited to those munitions, spare parts, and consumables that are critical to war fighting, and it should be recognized that responsiveness also assumes ongoing production. In addition, there might be a need for the capability to modify fielded systems rapidly as combat experience reveals operational shortcomings. Much of this immediate support in a wartime contingency would probably have to be maintained in a dedicated defense base, although some products, such as clothing and food, have sufficient commonality with the civilian production to allow for greater use of the civilian base.

The degree of foreign dependence that Turkey can accept in meeting identified surge requirements is a controversial issue, and one that should be addressed directly. Domestic laws cannot compel priority production of items by foreign manufacturers. Nevertheless, Turkey can hedge against defense production bottleneck in a crisis by stockpiling foreign-sourced parts. Since the responsive base will be devoted primarily to supporting military

equipment already in the field, some degree of foreign vulnerability may be unavoidable but can be minimized by developing multiple foreign suppliers.

Maintaining a selective surge capability requires complex and expensive planning. Indeed, the key to having a responsive base is to determine which items require a surge capability and to fund that capability. Industrial preparedness planning requires a coherent management approach and must be coordinated with realistic war reserve stocks to ensure rapid response in a crisis.

Production lines for selected surge items should be kept open with low levels of production and depot level maintenance of the items should be directed to production facilities thereby decreasing the cost of investment. Since peacetime production rates of these items are likely to be too low to support second-sourcing, Turkey will have to move toward greater reliance on single sources with additional surge capacity. When meeting surge requirements, civilian goods such as clothing, fasteners and subcomponents, and services such as maintenance and food service should be used whenever possible. Thus, preserving a rapid-response industrial capacity may require substantial changes in the defense-procurement statues and regulations to allow greater use of the commercial industrial base and sole-sources.

Having identified the limited number of items to be included in the responsive element of the base, the Turkish government may chose to fund the capability to surge. This funding should be considered as essential as to national security as funding for troop exercises or any other training or contingency planning. Surge simulations and exercises will also be necessary.

The Turkish government should be cautious about funding surge capability. To be successful, surge capability must be supported by stockpiles of components and parts required for production. However, maintaining such stockpiles is expensive and might be inefficient. It may eventually drain the economic strength of the nation. A better approach may be to stockpile finished goods in key war fighting areas. These stocks would be a strategic reserve.

c. Mobilization Base

While the responsive portion of the TDITB enables the nation to cope with less challenging but more likely theater-level contingencies, producing military equipment in peacetime at affordable prices requires access to a larger industrial base – partly dedicated to defense production and partly remaining in the civil sector. This mobilizable component of the production base provides a hedge against a great-power threat that can arise over a period of years. It comprises defense contractors whose products –tanks, ships, and fighter aircraft- will not be surged in lesser

contingencies, civilian factories and workers that can be transferred to defense production, and some foreign suppliers. Since rapid responsiveness is not a requirement, the defense plants in the mobilizable component of the base should be sized for small, realistic production runs to support the peacetime modernization of forces. In addition, reliance on a mobilizable base implies the maintenance of a robust, civilian manufacturing sector in electronics, machine tools, and heavy vehicles that is capable of converting to defense production in an emergency.

Recent developments in manufacturing technology have led to much interest in the so-called "factory of the future," which will make extensive use of automation and computer-aided design and manufacturing, relying less on computers and robots than on a new philosophical approach that emphasizes flexibility in meeting a wide variety of customer demands. Greater flexibility in manufacturing will require more integration of civilian and defense production. For example, it may eventually become possible to exploit the inherent flexibility of "dual-use" factories to manufacture military components that have no direct civilian counterparts. With the help of a small cadre of personnel in the dedicated defense base, dual-use factories can be capable of shifting from civil production to the manufacture of weapons in an emergency. Nevertheless, such truly flexible manufacturing systems

remain distant. Success of such an approach depends on access to raw materials and semi-finished goods that can feed wartime production.

To harness the country's total industrial strength against a major threat and to exploit future flexible manufacturing, weapons design should be determined more by commercially available technologies than by the desire to optimize military performance. Moreover, since the mobilizable component of the defense base is embedded in the larger civilian base, the strategy for transition to the future TDITB should be shaped by concerns for increasing the international competitiveness of Turkish civilian industrial base.

Maintaining the ability to make national security use of the mobilizable production base does not necessarily entail more government intervention, but it requires planning and better tracking of the changing capabilities of the base. Turkey should invest in establishing and updating databases that monitor the country's industrial resources and the Ministries of National Defense, and Commerce and Technology should assign more staff to follow defense-industrial issues. In those cases where MoND considers it essential to maintain a domestic capability to manufacture particular defense items, the government may have to invest in creating or maintaining a domestic source; in less critical cases, the decision may be made to source abroad. It is likely that

the mobilizable production base will place greater reliance on interdependence with allies than the responsive base.

3. Maintenance and Overhaul

The maintenance and overhaul component of the base consists of government facilities such as naval shipyards, air logistic centers, and army arsenals and depots, as well as private firms that maintain and repair equipment either at their own facilities or in the field. Maintenance and repair, always a critical factor in supporting military forces, will be increasingly important in a period in which currently available equipment will be retained for extended periods, due to the desire to lower defense expenditure to provide funds to boost the country's battered domestic economy. Several studies have indicated that up to 50 percent of the total cost of a weapon system are attributed to the operations and maintenance costs over the life of the deployed systems. Not only does it make maintenance and repair capabilities important, but it should also increase the importance of maintainability and reliability as design factors in weapon systems.

For most weapons systems, the maintenance and overhaul component of the base is generally confronted with limited requirements in the short term (5 to 10 years) and increasing requirements the longer systems are retained in inventory. The size

of the increase also depends on the effort devoted to designing improved maintability into new systems. Investing in this area can keep maintenance requirements low by historic standards, but maintenance improvements are rarely funded in military budgets.

An important question for this issue is whether maintenance should be performed by military overhaul/service depots/centers or by the private sector. Traditionally, maintenance and overhaul have been a responsibility of the military services, but a growing number of manufacturing firms, faced with the prospect of fewer contracts, are becoming interested in maintenance, remanufacture, and retrofit work.

In this matter, Turkey should seek to consolidate 4th level and 5th level maintenance responsibilities of the weapon systems and major defense equipment to only one level of depot maintenance and maximize the use of outsourcing these services to the producers of systems, so that their facilities are kept working and the cost of investment is lowered. The military services might argue that in-house maintenance facilities provide greater flexibility and responsiveness in supporting overall force readiness. Further, the services might be wary of over-reliance on private firms.

As mentioned above, the Turkish defense market is not likely to be large enough to accommodate more than one producer of major weapon systems like tanks, aircraft and helicopters, battleships and

submarines. On the other hand, if the facilities, which have been set up for providing the nation with domestic production capabilities, cannot be supported by increased exports in times of smaller national demand levels, it might keep these facilities alive to concentrate most of the depot level maintenance on them. Maintenance, overhaul, and upgrade contracts might be critical to maintaining design and production capability for some weapon systems such as armored vehicles. Additionally, retaining service maintenance and overhaul centers might also help increase the competition in providing higher quality and lower costs.

C. INTEGRATED DECISION MAKING AND BETTER MANAGEMENT

A sound, carefully devised defense industry and technology base strategy, which includes long-term planning objectives, can only be executed with qualified cadres in an integrated decision-making environment. Management of the DITB depends on skilled and experienced personnel. Currently, these skills are often lacking in Turkey's system because of the short tenure and inexperience on the part of many political appointees and military personnel. Therefore, as the first step, a creation of a professional civilian acquisition corps similar to those of France, Germany and other European countries should be considered immediately to provide quality management.

Although the Law No. 3238 has decreed a wide-based structure for the management and the coordination of the activities of TDITB, the current management of TDITB has been carried out by The Defense Industry Executive Committee, which is formed by the Chief of the General Staff and Minister of National Defense under the direction of the Prime Minister. Despite the fact that the law has ordered that the Defense Industry High Coordination Board would meet at least twice a year to provide the highest level of coordination and planning for defense industrial activities, the board has not ever met since the promulgation of the law in 1985. [Ref 63 p.11] This board consists of 14 members including the state minister responsible for Economy, Ministers of National Defense, Foreign Affairs, Finance, Industry and Trade, the Chief of General Staff, Commanders of Army, Navy and Air Force, and 3 other Undersecrataries. Therefore, in order to integrate defense-industrial policy with other industrial, economic, and social policies in a systematic way to develop a broader strategic-industrial perspective, Turkish government should take a broad view of national defense covering military forces, civil defense, and their economic and industrial underpinnings. In addition to the Ministry of National Defense and other military authorities, several non-defense agencies should be included in the higher level decision-making processes. Along with the Undersecratariat for Defense

Industry and Ministry of National Defense, the Ministries of Economics and Finance, Industry and Foreign Trade, and Transportation should participate in various aspects of defense-industrial planning. In contrast to a system where economic and security decision-making are segregated in different bureaucracies and there are few mechanisms for resolving conflicts between economic and national-security interests, Turkey should adopt a system where all the agencies, which have responsibilities that might affect national industrial infrastructure and TDITB, should be included to mitigate the risks of conflict in the planning and execution of inter-related strategies. Moreover the tendency to make decisions in a secretive, top-down manner, with limited accountability to Turkish Grand National Assembly (TGNA), the legislative body of Turkey, or the public should be regarded as a drawback of the current system and should be transformed into a structure where TGNA and the public can have more information about what is going on and hold the members of defense industrial management accountable for their conduct and decisions.

In an environment where long-term manufacturing plans are vital for the health of the industry, multiyear budgeting becomes an imperative to eliminate the effects of unpredictability. Currently the Turkish Parliament approves the annual defense budget as part of the whole government budget and votes on an overall spending

envelope rather than individual line items and weapon systems. The relative lack of parliamentary oversight and interference enables the government to manipulate the defense budgets to fund other major defense programs. Instead of this, a separate budget law for defense programs, which can cover more than one fiscal year, might be more helpful in eliminating the uncertainty about the future of the programs and ensure stronger support from the members of the parliament.

The improvement of the dialog between the TAFs and the defense industry can play a critical role in improving TDITB's role in international armaments cooperation. Therefore it is critical to provide a platform where industry can suggest ways in which TAFs can modify policies, procedures, and guidance to make Turkish companies more competitive participants in international teaming and export markets. Establishment of a standing industry body to develop the dialog, advise on and monitor the implementation of decisions, and to keep the TAFs leadership informed of additional industry concerns in the broad area of international defense trade might prove very useful.

Finally, Undersecratariat for Defense Industry should have the sole responsibility for weapon acquisition programs and arms exports. In addition to supplying the armed forces and safeguarding the autonomy of the national defense industry, SSM should adapt

the industry to Turkey's overall industrial needs and negotiate collaborative weapon development and production programs with other countries.

As mentioned above, Turkey should replace its current frail procurement system with a centralized, professional procurement system. There are four main advantages of a centralized, professional procurements system. First, senior officials (SSM) can enjoy high prestige and morale and manifest a strong sense of responsibility to the state. Moreover, whereas military officers move from one position to another, civilian officials remain with major weapon programs for several years, providing managerial expertise and institutional memory. Second, there is a more cooperative relationship between the government and the defense industry. One reason is that in an industry consisting largely of monopoly suppliers and a single buyer, there is little incentive for either party to criticize the system openly. However, there is also need for open, transparent procurement transactions with vigorous critical review.

A third advantage is that centralization enables the state to engage in multi-service procurements and consolidate R&D programs to avoid redundancy. It makes possible the development of a single weapon system for all three armed services. It can enable SSM to fund joint programs to develop technologies of use to all

services, including missile guidance, command-and-control systems, and logistics management; these technologies are then incorporated into service-specific weapon systems.

A final advantage of the system is that SSM can pursue a coherent strategy for managing the defense industry. SSM officials will have to seek to balance a variety of objectives, including force requirements, the health of both the defense base and the larger civilian industrial base, and political goals of the government. Because of the need for tradeoffs among these objectives, the system will not be designed to optimize individual weapon systems but rather to further the nation's military, industrial, and political interests.

Despite these advantages, a centralized procurement system may also suffer from a number of problems. The mission of preserving an autonomous defense-industrial base might sometimes be achieved by procuring national systems that cost more, perform less well, or take longer to procure than foreign-sourced weapons.

D. FREE MARKET ORIENTATION vs ADMINISTRATIVE GUIDANCE

One of the most important issues is the extent to which the government should intervene to manage the TDITB. On one hand, Turkey may allow the market forces to determine if they want to take part in defense industrial activities, and consequently decide

the size of their operations. On the other hand, Turkey can stress government participation and guidance in shaping the domestic defense industry.

As mentioned previously, the Turkish defense market is not expected to be large enough that it can have several competitors in almost every major sector. Therefore, it is very unlikely that there might be a domestic defense industry that can shape itself for the future through competition, organizational, or financial reasons. Moreover, the large amount of capital investment required to become a major player in the defense market and the prospect of unsatisfactory returns might prevent private sector from playing an active role in defense industry. On the other hand, Turkey's vital need to reach self-sufficient level in defense technologies and production implies that the administrative guidance will be essential.

The Turkish government should step forward to describe the TDITB in terms of capacity and technological superiority levels that can support Turkey's national security strategy by determining the extent to which existing forces and logistic supplies are not fully adequate to support that strategy. This analysis should be stated in terms of force structure, modernization, readiness, sustainability, and mobility. Turkey should use the analysis to calculate differences between current capabilities and the desired status, then

match the differences against the assessed capability of the TDITB to fill the shortfalls in a time certain. This procedure should define a TDITB --R&D, primes, lower tier, and strategic materials--that will assure that Turkey can:

- Maintain sufficient technological capability in mission-decisive functions and capabilities.
- Deter theater wars or, if deterrence fails, provide the military power to win quickly and decisively.
- Provide the resources needed to fulfill the government's responsibilities to deal with major natural disasters and terrorist attacks.

However, administrative guidance can take several forms from an old-style, strictly regulated model to mostly moral support from different government agencies, which can provide only limited resources for maintenance or restructuring.

Turkey should consider direct state intervention as the last resort, which may turn out to be not strong enough to force enterprises into adopting modern management techniques and increase efficiency. One crucial factor for the success of Turkey's efforts to develop and preserve a robust domestic defense industry will be a subtle but definite and efficient state backing of the defense industry. Since Turkey is still struggling to develop its national economy in general into a more efficient and productive form, a degree of macroeconomic regulation should be seen as indispensable if economic growth and modernization are to be accomplished. Decisions to promote certain sectoral industrial

policies affecting production of, for example, vehicles, electronics or machine tools should include the military-related industry.

It is also important that Turkey should set its defense industrial sector as much independent as possible from major political changes at the national level. The sector will certainly be affected by the general development of the economy, including macroeconomic factors such as inflation, unemployment and currency stability as well as the changing structure of industry. By preventing the political roller coaster from bringing fundamental changes in policy concerning the defense industrial sector, Turkey can ensure that the trends set in the initial period of macro-level planning will not change fundamentally. It also confirms that enterprise-level changes are likely to have increasing importance in shaping the future.

State protection and promotion should not be overextended to imply that the management of the defense companies can ignore market economy conditions.

At the same time, authorities should keep in mind that government decisions (and certainly their implementation) would depend on the availability of financial resources. In this matter, reinstating of the contributions from the tax on gasoline, which was cancelled after being in effect for a long time, might be a quick response to increase the amount of funds available to the industry.

E. EXPORT DEPENDENCE

One way of preserving a viable domestic defense industry and ensuring innovation is to expand internationally by seeking foreign investment and market access, i.e. increasing the amount of exports of the weapon systems and defense equipment produced. Foreign sales can maintain warm production lines for major weapon systems, aid national defense industrial responsiveness, and help pay for additional research and development costs. Moreover, even though international arms sales are greatly influenced by political and strategic considerations, international competition for export markets creates incentives for quality and price discipline.

The small size of the Turkish domestic arms market implies that once established fully, most defense firms will have to rely significantly on export sales to permit the economic procurement of weapons for Turkey's own use, by amortizing R&D and overhead costs over longer production runs. This will require the government and the defense industry managers to take export potential into consideration when launching a new development program, and the timing of Turkish military procurements will have to be tailored to meet the needs of foreign customers. Additionally, the buyers of the weapon systems might require the seller to provide the loan for the sale, and this might put additional burden on the Turkish

government to set up a financing system similar to US Foreign Military Sales.

However, export dependence is not immune to several factors that might affect the defense industry negatively. Exports might be adversely affected by a number of factors, including changes in oil prices, exchange rates, competition from traditional suppliers (US, UK, France, etc.), the emergence of new competitors, and the dumping of used East European weapons on the world market.

Heavy reliance on exports also tends to overshadow domestic procurement needs; in some cases, foreign contracts for domestic weapons might have higher priority than national orders.

The decline in arms exports might affect the defense industrial base both directly, by reducing level of production, and indirectly, by undermining the funding mechanism for defense R&D. Although the government might pay for most defense related research, industry will need to cover a significant share of weapon-system development out of profit from foreign sales. During the negotiation of an R&D contract, the government and the company will need to make an initial assessment of the system's export potential and determine on this basis a formula for an equitable sharing of R&D costs. Thus, the greater a system's predicted export sales, the larger the share of development costs that must be born by

industry. This cost-sharing formula may be renegotiated later if the export prospects of the system improve or worsen significantly.

The requirement that defense contractors internally finance a significant share of the development costs may give rise to a number of problems. First, joint funding might create strong pressures for arms exports, leading to some politically questionable sales. Second, company financing of R&D might enable the government to launch more weapons development programs than it can afford to carry through to completion, resulting in costly stretch-outs and delays. Third, a decline in arms sales might reduce the pool of money for company-funded R&D.

There might also be some economic and political drawbacks of over-reliance on export sales to support the defense industrial base – in particular, to subsidize defense R&D. Not only might the export imperative harm Turkish foreign-policy interests in some cases (e.g. importer countries might be sanctioned by UN resolutions), but unexpected downturns in export sales might limit the ability of Turkish defense firms to remain at the technological leading edge.

F. INTERNATIONAL COOPERATION

1. General

After a long period of hesitation, there has been a growing commitment to collaborative armaments programs and international

involvement among major producers of defense goods. As nations' defense procurement shrinks and defense technology becomes increasingly globalized, there will be growing incentives for international collaboration in defense R&D and production. While the integration and final assembly of weapon systems is likely to remain under national control, a growing number of components and subsystems containing the best available technology are expected to be developed internationally.

International cooperation is an important part of the globalization of the defense industry described in the previous chapters. It is an answer to the increased customer demand for more performance and complexity, leading to increased specialization, which at least for some companies requires an increased degree of cooperation. It is also a response to the increasing costs of weapon developments. Cooperation with foreign industries may include the following areas: research, development, production, marketing, support and subcontracting. This strategy gains access to a larger customer base and more capital through agreements with defense industries in other countries (partners). Shared risks and longer production runs are other benefits. As a result of specialization inside the joint project, R&D and production may partly move abroad, but the domestic industrial base remains relatively intact.

One common form of international cooperation is co-development, in which companies jointly develop and produce a weapon system. For maximum benefits, it is desirable if this also includes cooperation between the different armed forces from the very beginning, when requirements and specifications are decided. Cooperation normally also involves cost and benefit sharing over the whole life cycle of the system. Shared risks, costs and economies of scale are some of the benefits from co-development. [Ref 64 p.8]

One problem involved is that it can be difficult for countries with different geography and force structure to agree on the same specifications. Such agreement often is a necessity for obtaining maximum benefits. If the weapon system has to be developed and produced in different versions, most of the benefits from cooperation will not materialize. There is also a risk that part of the research and development, as well as production, may move abroad due to specialization inside the joint company, thus limiting the benefits for Turkish Industry.

Until the early 1980s, most of the development or co-production agreements were based on government to government agreements. [Ref 64 p.13] Normally, the governments also decided the work share for each country. This is not easy. It can lead to political disputes over each other's share.

Today, industry-to-industry defense collaboration is dominant, while the government initiated cooperation has stagnated. Where the latter exists, it is often a result of offset agreements. The first examples of industry cooperation are joint venture companies, a subsidiary jointly owned and operated by two or more defense firms. Well known examples are Euro-copter and Euro-missile.

In regard to Turkey, the globalization of science and technology makes most of the new discoveries abroad increasingly likely, either in the laboratories of foreign countries or the foreign-based subsidiaries of multinational firms. Therefore, maintaining cooperative scientific programs with allies is very important for Turkey to assure access to new developments with potential military applications. Nevertheless, excessive dependence on allies is not desirable. While it will be too costly and practically impossible to endeavor to stay ahead in all areas of defense technology, Turkey should try to develop and retain world-class competence in critical sectors. However, the technological superiority of the US firms forces European and especially Turkish companies to construct alliances with these firms. In this context, US policy of restriction of arms and technology transfers causes this kind of cooperation to be hard, and European firms may be more willing to transfer technology to foreign countries to compete with the technologically advanced US companies. International cooperation may promote that

competence, but only if the Turkey benefits as much from cooperation as its partner. For this reason, Turkey must ensure that future international cooperative programs provide for reciprocal flows of technology, and that mechanisms exist to transfer dual-use technologies developed through international civilian R&D efforts to Turkish defense applications.

2. Integration With European Defense Industries

In the years following the World War II, the United States was the NATO defense market's principal supplier. This arrangement served both U.S. and NATO interests in rapid European rearmament, interoperability and standardization of weapon systems, and efficient production. However, each European country bought equipment of its own, and most countries had at least one state-owned company churning out guns, planes and missiles. For cutting edge weapon systems, Europe turned to US contractors, increasing Washington's willingness to help protect countries an ocean away.

Over time, Europe rebuilt its own design and production capability, first through licensed production of US systems and offsets, then gradually, under growing national sentiments and strengthening European economy, through the rebuilding of an indigenous industry. Today, the larger NATO European allies rely

primarily on domestic or European systems, while smaller countries, like Turkey, are still heavily dependent on US-designed systems.

After the cold war, the military expenditures of the US and the European countries have declined dramatically. Because of this decline, the market for the military arms producers decreased significantly, too. Moreover, the consolidation of the arms producers in the US caused the European firms to take some precautionary steps towards increasing competitiveness, which has been already in a weak form. European countries' most obvious response was the gathering of more than a dozen handful multinational players that rank among the world's largest. These new companies have the ability to produce the same equipment for several European countries at once. They could also compete with American giants such as Boeing Corp., Lockheed Martin Corp., and Northrop Grumman Corp.

The motivation is mostly economics; integration cuts the costs and yields more sophisticated systems. When each European country develops its own projects, defense funds that could be channeled into high-tech systems are wasted on overlapping low-tech overhead. Multinational firms are offering lots of countries the same planes, helicopters and missiles. Common defense systems can also ease integration within the multinational defense force of the proposed European defense identity.

Table VII-1 Europe's Defense Industry Consolidation

Joint Venture	Products	Partners
Matra BAE Dynamics	Missiles	**1. BAE Systems (UK): 37.50 %** British Aerospace (UK) Marconi Electronic Sys. (UK) **2. EADS (France-Germany-Spain): 37.50 %** Aerospatiale (France) Matra Hautes Tech. (France) Construcciones Aeronauiticas (Spain) Daimler Chrysler Aerospace (Germany) **3. Finmeccanica (Italy): 25 %**
Alenia Marconi Systems	Avionics	**1. BAE Systems (UK): 50 %** **2. Finmeccanica (Italy): 50 %**
European Military Aviation Co	Military Planes	**1. EADS: 50 %** **2. Finmeccanica (Italy): 50 %**
Astrium	Space Systems	**1. BAE Systems** (UK): 25 % **2. EADS: 75 %**

Source: Wall Street Journal, 9 March 2001, p. A11

As part of the Western European Union (WEU) and one of the prospective members of the European Union (EU), Turkey should continue its current activities in the joint research and technology activities in the structure of NATO and the Western European Union (WEU). Close European defense cooperation should be a top priority for Turkish defense industry as a way of sharing R&D costs, expanding markets for its domestic firms and most importantly, transferring advanced military technology. On the other hand, it should be kept in mind that this does not necessarily require

international and cross-border mergers, which are not so easy. Differing national interests, military and foreign policies, employment and other constraints makes it very difficult to achieve a completely integrated European DIB.

Table VII-2 Major European Defense Projects

Program	What It Is	Value of Program	Countries Developing	Status
Euro-fighter	Fighter Jet	$ 12 billion (208 orders)	Germany, Italy, Spain, UK	In Production
NH-90	Military Transport Helicopter	$ 4 billion (298 orders)	France, Germany, Italy, Netherlands	In Production
Tiger	Combat Helicopter	$ 1.5 billion (160 orders)	France, Germany	In Production
Scalp/ Storm-Shadow	Cruise Missile	$ 1.5 billion	France, Italy, UK	In Production
A400M	Military Transport Plane	$20 billion (Projected)	Belgium, France, Germany, Italy, UK, Netherlands, Portugal, Spain, Turkey	In Development (Awaiting Funding)
Meteor	Air-to-Air Missile	$1.5 billion	France, Germany, Italy, Spain, Sweden, UK	Ordered / In Development
Galileo	Global Positioning System	N.A.	France, Germany, Italy, UK	Under Discussion
Sostar	Airborne Ground Surveillance	N.A.	France, Germany, Italy, Netherlands	Under Discussion

Source: Wall Street Journal, 9 March 2001, p.A11

G. CIVIL-MILITARY INTEGRATION

1. The Context and Justification

Civil-Military Integration (CMI) is a concept that advocates bringing together the commercial and military sectors of industry, so both commercial and military work can be performed in a common facility using commercial processes and practices. [Ref 65 p.398] It can be defined as the process of merging the Defense Industry and Technology Base with the larger Commercial Industry and Technology Base (CITB) into a unified National Industry and Technology Base.

Integration of civilian and military operations, and other associated issues such as diversification, conversion, and "dual use" of both R&D and products, have been one of the most addressed topics for the last 10 years. Besides the obvious need for defense firms to shift to other markets in order to remain healthy, other good reasons, which make these highly interrelated issues so critical, have surfaced:

- First, only in recent years has commercial technology evolved so rapidly that in many areas (e.g., electronics) the commercial world actually is ahead of the defense world in new technologies and high performance, even for the same rugged environments.
- Second, as military equipment has become more and more dependent on advanced electronics and other "dual use" technologies, there is a growing overlap between technologies that are critical to defense industries and those that are critical to nations' international competitiveness.
- Third, since the 1980s process (production) technology has been shifting toward "flexible manufacturing technologies"

wherein factories can now be as efficient with small-volume, multi-product production as they could have been in the past with single-product, automated mass production.

- Fourth, military equipment costs have grown from generation to generation of weapon systems, such that a single aircraft, ship, or tank is so prohibitively expensive that only very few (perhaps an inadequate number for a viable defense posture) can be produced. Thus buyers of weapon systems and defense equipment are forced more than ever to consider production costs and equipment quality as equally important as the traditional emphasis on weapons' performance. Similarly, R&D trends in weapon systems have resulted in a mounting requirement to shrink longer development cycles, which in some cases has exceeded the typical technology obsolescence period. Therefore, defense firms and their buyers need to begin to emphasize much more rapid "new product realization. " This shift in emphasis--to cost, quality, and rapid development has brought defense equipment requirements far closer to the needs of the commercial world. [Ref 65]

Each of these four changes, which have been more or less felt by most nations, clearly have encouraged governments and their defense suppliers to move in the direction of enhanced civil-military integration. In Turkey's case, perhaps the major rationale--from the public policy perspective--for moving in this direction will be the recognition that in the presence of the immediate need to reduce the defense budget to support the nation's efforts to create a more sound economy, it simply will be too expensive for the country to maintain an efficient, innovative, responsive, and healthy defense industry if it subsidizes a unique and isolated industrial structure in all areas of technology critical to defense needs. Moreover, a smaller defense-only industrial base may not have the capacity to

quickly respond to a crisis. With CMI, Turkey can use the manufacturing capacity of the entire nation without a lengthy process of retooling and build-up.

Integration implies that many industries can employ the same technologies, personnel, administrative procedures, research and production facilities for both commercial and military customers. The results are a larger industrial base available for defense production and greater economies of scale--and hence lower costs and higher quality--for defense products. Such an approach might not have been possible in past, when defense technology was usually more advanced in performance and was designed for more severe environments than commercial equivalents and when commercial production required high volumes to achieve efficiency. Today, however, commercial product and process technologies have advanced to the point where such integration is both possible and desirable.

CMI is intended to maintain competitiveness, and also the ability to resurge in the case of increased threat, by relying more on commercial products, processes and buying practices. Increasing the integration between military and civilian industrial technology and production will lower overall defense costs, promote technology transfer, increase available industrial capacity and strengthen the economic dimensions of national security.

From the industrial perspective, it is essential that firms that have been doing defense business find other markets in order to remain healthy, competitive, and growing. Similarly, from the government's side, the MoND and armed services must learn to do much more of their business with the civilian economy (from buying products and services to using commercial specifications, standards, procurement and accounting practices, etc.)

The most important aspect of the decision on CMI is that Civil-Military Integration should be pursued on a case-by-case basis. Greater use of commercial technology might make sense in areas such as electronics and aerospace, where defense and civil requirements are often similar, but not in military-unique fields such as missile propellants and gun tubes. When the use of commercial technologies is appropriate, such use can usually provide a particular capability at lower risk and cost, while expanding the mobilization potential of the civilian industrial base. Therefore, it is particularly important to point out that there will still be a need for certain areas with specific defense-unique technology. But it does not necessarily mean that those products must be considered unique and be produced in an all-military industry. When examining the materials, components, and subsystems that the products are made up of, there are often

commercial counterparts that are less costly, more advanced and capable of satisfying the same environmental conditions.

2. Achieving Civil-Military Integration

Civil-Military Integration can occur through conversion of existing defense plants to commercial products, diversification of defense companies into commercial product lines, or using dual-use technologies, where a single production line can produce both civilian and military components.

Defense conversion, which is the conversion of military capacity to civilian capacity, is generally seen as a way to avoid layoffs, plant closings, and business failures in the face of downsizing of defense market. It implies that the company stops making some military products and changes over to civilian ones, i.e., totally or in part moving over to civilian production and broadening the product base. People who are working on military projects then work on civil ones and factory facilities that were being used for military products are turned over to a civilian workforce. [Ref 66. p1] The strategy's goal is to retain an industrial base available for military production, but at the same time not be totally dependent on military customers. Other possible benefits include greater economies of scale, lower costs, and higher quality. Conversion is not without obstacles. Successful defense conversion

depends on emerging new markets for the expansion of existing markets. Without them, defense-dependent firms must compete with, and their products displace those of, established suppliers. There are potential markets that may be able to make use of the existing defense technology. However, it is not clear if those markets will materialize, or are expanding sufficiently, or can ever be large enough to fully utilize the defense industries' capacity. Since there are already firms established in these markets, growth must be substantial to support new entrants.

An alternative strategy being followed by some firms is diversification outside the defense market by acquiring new capabilities or redirecting current ones. Diversification refers to a defense firm acquiring a commercial firm or starting a new commercial product line. It is an effort by a firm to reduce reliance on one particular market or one customer. [Ref 67. p.91] "When defense contractors have successfully diversified, rarely has the source of competitive advantage rested on technology transferred from military side of the business." [Ref 68 p. A12] Indeed favoring diversified firms above non-diversified firms for procurement might be a good strategy because only a diversified firm might be strong enough to turn down a poor defense contract and thus avoid repeating some of the severe financial mistakes related to fixed-price development contracts. Another diversification strategy is to

engage in joint ventures and teaming arrangements. By pooling financial resources, technology, and skilled labor, two or more firms can enter a market where a single firm cannot compete on its own. To the extent that firms offset defense cutbacks with growth in commercial sales involving similar technologies, they may mitigate the adverse effects on overall military production capabilities of declining levels of defense procurement.

Another strategy for CMI is dual-use technologies. Dual-use technology refers to finding products or services that can have both military and commercial applications. It is a two-way plan that helps defense firms enter the commercial market and commercial firms enter the defense market. It can be defined as products, services, standards, processes, or acquisition practices that are capable of meeting requirements for military and nonmilitary applications (It will be discussed in more length in the next section).

Two expressions related to the benefits of civil-military integration are:

- **Spin-off**: The non-defense commercial viability of technologies, components, and products already developed for defense purposes.
- **Spin-On**: The defense utility of existing non-defense, commercially viable technology, components and products with emphasis given to technologies that could improve the affordability of military systems. [Ref 69]

Spin-off has been a factor in the defense debate for a long time. The latter one is a more recent entry. One reason for this is that it would have been almost impossible to take some of these approaches only ten years ago. Up until now, defense technology has almost always been more advanced than its civilian equivalent. Today, however, civilian product technology is often more advanced, and production technologies have advanced to the point where integration is not only possible, but also desirable.

3. Lessons Learned

Having to cope with drastic reductions in demand, defense industries, almost worldwide, have been moving toward CMI since the end of cold war. CMI attempts have been faced with a number of obstacles such as the surge in global competition, high barriers to entry into high-tech markets, and often, weak economies. Accordingly, Turkey can draw very useful lessons from the experiences of these countries.

In general, defense firms might have difficulty breaking into commercial markets because of high overhead costs and a lack of understanding of commercial business. On the other hand, commercial firms may need to make capital investments in special processes, test equipment, and tooling to meet government requirements that are rarely useful commercially. Experience has

shown that most defense firms have had very tough times converting from the high-overhead, "cost-plus" culture to compete in commercial markets. Conversely, heavily commercial firms tend to view government business as unpredictable, low-profit, burdened with onerous regulations, and carrying the potential for loss of proprietary information.

When utilizing CMI strategy, the company wants to integrate military work with civilian work and/or expand into the civilian sector. New products are added to increase the customer base and gain capital and knowledge for increased competitiveness in the defense market. This involves the increased use of civilian components and standards. R&D and production remains in the country. A firm trying to enter a new market faces uncertainty regarding customers and requirements. A firm that is used to an environment with one or a few customers may have difficulty trying to understand new commercial markets, especially if the firm lacks the necessary marketing skills and organization, including distribution networks for dealing with a broader, more dynamic customer base.

Another factor is the access to capital. The firms with the greatest need to convert are often the weakest financially, so they may encounter problems in the capital markets. There are mainly two factors that are against them. They probably have declining

defense sales and they are trying to compete in an unfamiliar market. They therefore will not usually command the highest credit rating.

There are also structural barriers for defense-dependent firms. The most fundamental structural difference is that the defense market has one dominating buyer, the armed forces. Despite exports, the defense industry is mostly a domestic market. Also for any given defense product there is in most cases only one domestic supplier. Finally, the ultimate good being purchased (i.e., national defense) is a public good that is difficult to price.

The difficulty of putting a price on national defense has in many cases allowed performance to dominate over the cost. Consequently, military technology has in some instances reached a level of costly sophistication for which the civilian sector may not be willing to pay. The complexity of military systems has led to a long development process favoring revolutionary, but slow, innovation. The defense industries have gotten used to research, design, development and production cultures that may not function well in a more cost-conscious and dynamic market environment. Recent years' increased competition has put pressure on the industry. Today defense industries are forced to be more competitive.

There is a perception that defense technologies are unique because of the way the government procures them. In developed countries, Government regulation has, at least to some degree, prevented the industry from integrating military and civilian production. In general there are three main areas of regulation that create barriers to civil-military integration: accounting requirements and audits, military specifications and standards, and unique contract requirements. To facilitate the move towards integration, the military must encourage new types of specifications allowing dual use. This might be especially helpful to those industries already having commercial production. In countries where the greater use of commercial products and processes in the defense sector is obstructed by legal and regulatory obstacles rather than technological, there is a greater differentiation between defense businesses and other segments of the national industry. This fact compels the diversified firms to set up separate defense divisions. On the contrary in countries where there are less or almost no legislative, regulatory, or accounting barriers between civil and military procurement, firms have greater flexibility to use commercial practices in the defense sector. This flexibility enables firms to produce military and civil products in the same factories and to rely extensively on dual-use technologies and processes, improving efficiency and reducing overhead costs.

Government should be careful not to impose policies that might create obstacles to civil-military integration. Procurement rules should accommodate commercial practices and avoid constraining the industry's ability to perform military and commercial work in the same factory. Performance and manufacturing specifications should not be overly rigid, which tend to suppress innovation; competition should not be mandatory; cost accounting rules and certification requirements should not be too rigid.

Civil-military integration might require a complete overhaul of Turkey's acquisition policies. First, MoND must be more willing to tailor its requirements to what is commercially available. Second, auditing procedures must be set to permit the use of identical parts and components in military and commercial products produced by the same firm. Third, defense procurement practices should become more similar to commercial ones. Finally, government should support R&D on dual-use technologies with both defense and civil applications, and make seed money available through loans or grants for civil initiatives by defense firms.

For this to be successful may also require the government to make some policy changes. First, it could review laws that tend to isolate defense industries from the broader national industrial base. Second, as previously mentioned, the armed forces need to accept

commercial and international standards in place of military specifications. Third, as a shift towards greater civil-military integration may require changes in the way research and development is carried out, the funding may have to shift from military unique R&D, towards research on dual-use technologies.

H. DUAL-USE TECHNOLOGY

One means to sustain the defense industrial base and provide enough business to sustain contractors within the base would be to apply the concept of dual-use technology. The dual-use of technology is defined as

> ... technology that has an indeterminate number of potential uses, at least some of which are of significant military importance and some are of material non-military importance. [Ref 69. p.37]

It can also be defined simply as an application that has both military and commercial uses. The technology can result from a military development and "spin-off" for use in the commercial sector, or result from a commercial development and "spin-on" to a military application.

Dual-use technology encompasses "everything" that results in the design and production of a major weapon system and its commercial counterpart. It includes the information, scientific, theoretical and mathematical procedures used in this development

and production process, no matter how common or uncommon they may seem. [Ref 70. P.4]

The need for dual-use arises from several factors such as the decrease in defense budgets; commercial research and development (R&D) outpacing defense R&D investments. It may also be seen as a way of reducing operating cost and overhead by spreading this cost over a larger base. This orientation can also increase the surge capacity of the producers in the base.

Turkey should have a dual-use technology strategy that aims to move toward a cutting-edge national technology and industrial base that will serve military as well as commercial needs. This dual-use technology strategy should allow the armed forces to exploit the rapid rate of innovation and market-driven efficiencies of commercial industry to meet defense needs.

Dual-use technology can be accomplished mainly through (1) support for research and development, (2) integration of civilian and military industries, and (3) insertion of commercial technologies in development, production and support of military systems.

As mentioned previously, through using an agency, which is responsible for defense R&D and targets investment in defense related areas such as computer hardware, software, electronics and simulation that have defense applications as well as commercial

applications (like DARPA of US or DRET of France), Turkey can take advantage of advanced commercial techniques. Related civilian research in dual-use technology will also be of benefit for defense, although the size of the payoff will depend on the technology in question. For example, there may be important "spin-ons' – transfer of technology from the civilian sector to defense – in areas of microelectronics, displays, and software production. Nevertheless, civilian technology has little relevance to important military technologies such as stealth, many areas of defense electronics, and nuclear hardening.

Integration of defense and commercial production can be accomplished through either of two ways. First, a commercial application for defense technologies can be found to make production more affordable through economies of scale. Second, flexible manufacturing can be promoted so custom military products can be produced on the same assembly line as commercial products with minimal retooling. Flexible manufacturing refers to the ability to manufacture different items off the same assembly line with minimal number of changes or retooling. Building military products on commercial production lines can help reallocate fixed infrastructure costs and take advantage of the efficiencies of "cost-conscious, market driven commercial practices"

Commercial technology insertion takes advantage of new commercial technologies that are available while a weapon system is in development or upgrade. By inserting the best commercial capabilities, materials, products, and processes into military systems, Turkey can ultimately realize faster implementation of leading-edge technology into weapons systems and defense equipment at a much lower overall price. The use of rapidly developing commercial technologies should improve the performance, affordability, and delivery schedule of weapon systems. In order to be able to insert commercial technologies and products into military systems, commercial products must be able to perform in a military environment that may be more stressful on the component or system than a commercial environment. If the risk is low and substitution possible, then commercial units might generally be less expensive.

IX. CONCLUSION

A. TURKEY NEEDS A ROBUST DEFENSE INDUSTRY

The end of the cold war has created a safer environment for most nations and reduced the need for fielding huge armed forces and vast investments for defense. In some countries, defense budgets have been reduced by about 40 to 50 % in real terms and savings have been devoted to other areas such as lowering national debt, improving national infrastructures for education, health and social security; developing technological base, etc.

However, due to her very special strategic position and historical responsibilities, Turkey still faces a range of substantial threats to its national interests, physical security, economic well being and to the safety and security of its friends, and to its far-reaching security interests. These threats require the maintenance of a broad set of military capabilities in order to deter, and if necessary, to fight and win any future conflict. In the future Turkey may face challenges to its national security from states, which are technologically sophisticated and can afford the resources necessary to build a military establishment which is an equal of Turkey's or even better. Therefore, Turkey needs a stable, robust defense industrial base, which is capable of developing a full range of major weapon systems, including fighter aircraft, main battle tanks, submarines and surface ships (nuclear and conventional), and an

array of missiles. This requires several steps to be taken by both government and industry to maintain competition in the development and production of defense goods and to ensure that critical skills are maintained.

The defense industry and technology base should be seen as a crucial element of Turkish military strength, because if appropriately developed and maintained, it will be the major source of providing the capability to develop, produce, and support military systems in peacetime and to respond to additional military requirements in crisis or war. It should be seen as "the fifth service," ranking in importance only after the Army, Navy, Air Force and Gendarmarie.

B. TURKEY NEEDS BETTER PLANNING

The authors of this thesis strongly believe that, for defense industry (as for other forms of economic activity), success and prosperity are created, not inherited. One lesson that has become clear from our review and analysis of the problems and prospects facing the Turkish Defense Industry and Technological Base is that creating the conditions for success is very complex and difficult task. Defense industry executives and government policy makers must deal with an array of pressures, ranging from changes in the international security and political-economic structures to emerging

trends in the international defense market; within Turkey, the domestic political and economic realities of defense procurement rather complicate the choices that must be made.

Our task here, indeed our explicit objective, has not been to write a definitive guide for those charged with charting future path of the defense industry in Turkey. Rather, we have sought to identify and clarify as comprehensively and systematically as possible the issues that might affect the decision-making processes about the future of a domestic defense industrial base, with a view assessing the abilities of the current defense industry and technological base in supplying weapon systems and defense equipment to Turkish Armed Forces and international markets.

We believe that efforts to develop and maintain the TDITB should be focused on 1) reallocating resources from short-term military capabilities to long-term potential for developing and producing weapon systems and defense equipment, and 2) exploiting the synergies that can result from a closer integration of the R&D, production, and maintenance elements of the base. For example, the future TDITB might seek to integrate R&D and production through a "prototyping-plus" strategy that involves the continuous development and limited production of selected prototypes during the periods between full production programs. Defense manufacturing might be maintained through some combination of

low-rate production, greater integration of the civil and military industrial bases, and the changes in procurement of spare parts and maintenance services.

Turkey should pursue an active defense industrial policy focused on two axes. The first policy axis should seek to develop and promote the technological competencies of the defense industry. To this end, it should encourage defense contractors to diversify into the commercial sector, promote the integration of civil and military production investing in defense R&D at the expense of current production, urging firms to concentrate on areas of excellence to improve their competitive advantage, and promote greater reliance on dual-use technologies. The second policy axis should aim to enable Turkish defense firms to play a significant role in the restructuring of defense production on the European scale. This goal should be pursued through collaborative research and development programs, strategic alliances, and other forms of international collaboration in defense R&D and procurement. Moreover, Turkey should also seek ways to cooperate with newly independent Turkic republics.

The Turkish government should have two partially competing objectives: creating and maintaining a broad defense-industrial base capable of furnishing the full range of equipment required by the armed forces (possibly even when superior or less expensive

weapons are available from foreign sources); and procuring military systems at an affordable cost. Because of the central importance of the defense industry to the country's defense posture and technology posture, Turkey should place considerable emphasis on identifying and preserving key design and manufacturing skills in the major defense firms. This requires a comprehensive planning, programming, and budgeting effort, supported by long-term military programming law (which sets financial targets for defense procurement) and the annual defense budgets.

C. STRATEGIC CHOICES AND TACTICAL DECISIONS

Turkey faces some broad strategic choices about the nature of the future defense industrial base, including:

- The degree of international interdependence versus national autonomy,
- The degree of reliance on the integration of civilian and military sectors versus an arsenal approach, and
- The allocation of resources between maximizing short-term military power versus the potential to develop and produce new weapons when needed.

One strategic choice relates to the extent to which the TDITB will be integrated into the world economy. Turkey must choose the degree of defense industrial autonomy that is necessary and possible in an increasingly global technological environment. There are risks both in excessive reliance on foreign sources and in attempting to be fully autonomous. In the former case, Turkey might risk not

having both critical capabilities and control over which technologies are pursued; in the latter case, it risks higher development and procurement costs, protected industries that lack innovative drive, and loss of access to foreign technological developments. The optimal trade-off between interdependence and autonomy will depend on the industrial and technological sector and the military importance of the technology.

A second choice relates to the internal structure of the base. There are two alternatives for dealing with this front. On the one hand, Turkey can choose to rely solely on arsenals, either government or privately owned, that might be sole–source producers of particular military systems. On the other hand, it can modify its military requirements to conform to what might be available from the commercial sector. An optimal strategy may be to rely on the civilian industrial base whenever possible, depending on arsenals for those areas of defense development and production having little or no overlap with civilian technology, or where only monopoly producers can survive.

A third choice concerns the allocation of resources between maximizing short-term military might versus the potential to develop and produce new weapons when needed. Managing defense R&D and procurement to create and preserve a broad-based national defense industry for the future, but at some cost to its short-term

military requirements might benefit the country and the broader national defense industrial infrastructure. A quest to maximize short-term military capability might cost to long-term health of country's defense industrial base. Therefore, Turkish policymakers should find an optimal balance between these two main strategies.

Technology should be produced and placed on the shelves of nation's laboratories and called upon to place in the hands of military forces in the field. It is important to prepare technologically for everything an adversary might decide to do, but because of uncertainty and financial limitations, building very little for the field until it is surely known what is going to be needed might help the nation with using its resources more efficiently.

Instead of engaging in physical and labor-intensive defense, more technology, ideas and use of information technologies should be employed, as in the example of commercial production. It should be noted that in developed countries, there is a growing statistical discrepancy between Gross National Product and Gross National Income, since ideas have been replacing physical bulk and effort as creators of value.

Unlike countries such as US and France, which developed huge defense capacities and faced the problem of overcapacity since the late 1980's, Turkey can ensure the financial, structural and technological health of the defense industry by engaging in long-

term planning and various forms of administrative guidance to. The US example of relying primarily on market mechanisms rather than government intervention runs the risk that firms that are the sole source for key components or that possess critical design and manufacturing skills may go out of business or leave the defense market.

Before drawing some useful lessons from the successes and failures of other nations, which have already experienced the painful task of restructuring the current defense industrial base to meet the requirements of future fiscal and security conditions, Turkish government authorities should remember that some of the actions taken by other countries may not be appropriate to the Turkish economic and political context. To cite an example, rather than seeking quantum leaps in military performance at enormous cost; an evolutionary, low-risk approach to weapons development, which may forego some uncritical performance requirements in order to limit program costs and technological risk or to develop systems suitable for export to developing nations, may be more appropriate to the emerging fiscal and security conditions.

With budgetary limitations and vital public needs in mind, acquisition strategies of new-technology, expanded-capability, high-cost weapon systems should be considered thoroughly. The choice simplifies to developing and procuring less capable (and thus less

expensive) systems in numbers large enough to provide a mass defense approach; or developing and producing the most advanced systems of which are capable, but in smaller, "silver bullet," numbers. We would lean toward the latter, augmented with the concept of 'high-low" mix. This means that while an arsenal of more expensive but highly capable weapon systems can only be afforded in small numbers, their force-multiplying effect should then be bolstered by low-end, lower cost, and lower-capability systems which can be procured in large numbers. The resultant "high-low" mix offers both volume and capability.

In its efforts to increase its own industrial base and technological know-how, Turkey should give priority to request co-production agreements, which is a good way of transferring technology. It should require its partners to teach and transfer technological processes. It should also continue to seek offsets to reduce the financial impact of its purchases from the foreign sources as well. However, it should keep in mind that developed countries have been going through a period of "creative destruction," the process by which emerging technologies push out the old, marshalling the increasingly obsolescent technologies to finance the newly produced capital assets that embody cutting-edge technologies. Turkey should not be a dumping field of such old technologies.

Overall, Turkey should spend more resources developing and testing military systems without any commitment to full production. Emphasis should be placed on research and development to create a storehouse of technology, from which critical weapon systems may be derived, as affordable. Defense industry and technology base plan should include consolidation, diversification into the civil sector, shifting emphasis from production to R&D, integrating civil and military production and international collaboration. It should include short-term surge capability, medium-term expansion capability where possible and value-added, and long-term reconstitution capability in TDITB.

APPENDIX-A FREE MARKET THEORY VS. DEFENSE MARKET PRACTICES

In his 1989 book, "Affording Defense" Jacques Gansler listed several areas where the weapons market and free market theory were different.
The below table gives Gansler's view of the practices in the defense market compared with the tenets of free market theory.

Free Market Theory	Defense Market Practices
Many small buyers and suppliers	One buyer (Govt.) and few large suppliers
Most items are small, and bought in large quantities	Each item is extremely expensive, and bought in very small quantities
Free movement in and out of the market	Extensive barriers to entry and exit
Prices are set by marginal costs	Prices are proportional to total costs
Prices are set by marginal utility	Almost any price is paid for desired military performance
Prices fall with reduced demand to encourage buying more	Prices rise with reduced demand due to total-cost based pricing
Supply adjusts to demand	Large excess capacity
Labor is highly mobile	Greatly diminished labor mobility
Decreasing or constant returns to scale (operating difficulty)	Increasing returns to scale (in region of interest)
Market shifts rapidly with changes in supply and demand	7-10 years to develop a new system, then at least 3-5 years to produce it
Market smoothly reaches equilibrium	Erratic budget behavior year to year
General equilibrium- assumes prices will return to equilibrium value	Costs have been rising at 5-7 percent per year excluding inflation
Profits are equalized across economy	Wide profit variations between sectors; even wider between firms
Perfect mobility of capital (money)	Difficulty in borrowing
Capital (equipment) is mobile with changing demand	Large and old capital equipment "locks in" companies
No government involvement	Government is regulator, specifier, banker, judge of claims etc.
Selection is based on price related factors	Selection is based on promised performance
No externalities	All busineses working for government must satisfy requirements of osha,eeo, awards to areas of high unemploymwent, etc
Profits are a return for risk	Profits are regulated, primarily as a percentage of costs
All products of a given type are the same	Essentiaslly each producer's products are different
Competition is for share of the market	Competititon is often for all or none of a market
Production is for inventory	Production occurs after a sale is made
Size of the market is established by buyers and sellers	Size of the market is established by "third party" (comngress) through annual budghetbuyers and sellers
Demand is sensitive to price	Demand is "threat sensitive", or reponds to availability of new techynology; it is almost never price sensitive
Technology is equal throughout the industry	Competitive technologies
Relatively stable multi-year commitments	Annual commitments, with frequent changes
Benefits of the purchase goes to the buyer	A "public good"
Buyer has a choice of spending now or saving for a	Govt. must spend its congressional appropriations

later time	or might lose it.

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